ADVANCE COPY

SCIENCE

29 July 1955

Volume 122, Number 3161

Editorial From Alamogordo to West Milton 181

Articles Men and Their Sciences: *W. Borberg* 183

Steps in the Oxidation of Indoleacetic Acid: *P. M. Ray* and *K. V. Thimann* 187

News of Science Scientists Appeal for Abolition of War; Traveling Science Libraries for Small High Schools; *Virology*, a New Journal; Commercial Electric Power from Atomic Energy; NIH Directorship Changes; Genetics of Extinct Species; News Briefs; Scientists in the News; Necrology; In the Laboratories; and Miscellaneous 189

Reports and Letters Radiation Sensitivity of Dormant and Germinating Barley Seeds: *C. F. Konzak* 197

Methylamine Complexes of Yttrium Chloride: *W. W. Wendlandt* 197

Frenquel Corrects Certain Cerebral Electrographic Changes: *F. Rinaldi* and *H. E. Himwich* 198

Influence of Calcium on Mobility of the Electrophoretic Components of Chicken Blood Serums: *A. T. Ericson, R. E. Clegg, R. E. Hein* 199

Agglutinating Strains of Trypanosomes Obtained with Oxophenarsine: *W. Cantrell* 200

Science, Population, and Arid Lands: *A. M. Woodbury* 200

Measurement of Activity of Compounds Traced with Low-Energy Beta Emitters: *J. C. Roucayrol* and *E. Oberhausen* 201

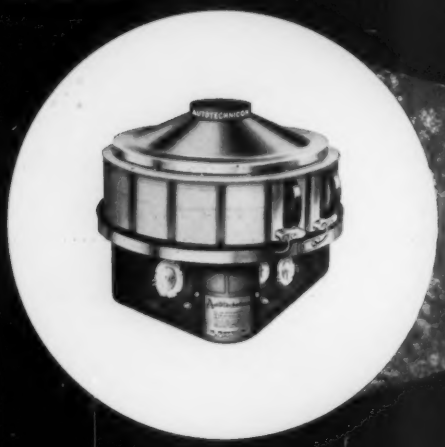
Latex Micro-Molding and Latex-Plaster Molding Mixture: *D. Baird* 202

Book Reviews *Colchicine—in Agriculture, Medicine, Biology, and Chemistry; A Manual of Paper Chromatography and Paper Electrophoresis; Annual Review of Nuclear Science; Les Bactéries Lysogènes et la Notion de Provirus; Differential and Integral Calculus; Advanced Mathematics for Engineers; Magnetic Amplifiers; Physicochemical Calculations; Enzymologie; The Biology of Man; Statistical Problems of the Kinsey Report on Sexual Behavior in the Human Male; Health Careers Guidebook; Genetica Medica; Nuclear Physics*; Books Reviewed in *The Scientific Monthly*; New Books; and Miscellaneous Publications 203

Scientific Meetings Fatigue of Metals; and Forthcoming Events 208

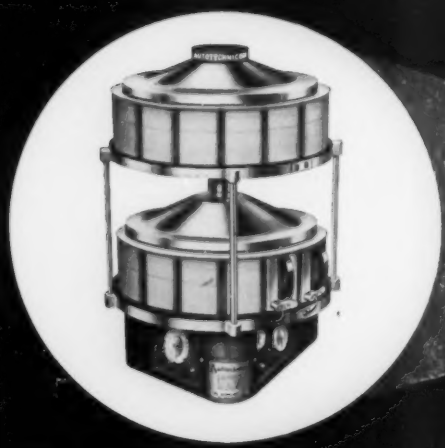
AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

announcing new models of the



Autotechnicon mono

This new single-deck model is as dramatic in improved efficiency as it is radically different in appearance from earlier Autotechnicons.



Autotechnicon duo

Boon to the busy laboratory . . . processing or staining at will without annoyance of shifting beakers.

Autotechnicon®

hallmark of excellence in automatic tissue processing

Write today for Booklet 2-A, for description of these new instruments.

THE TECHNICON COMPANY

Chauncey • New York

for better photomicrography

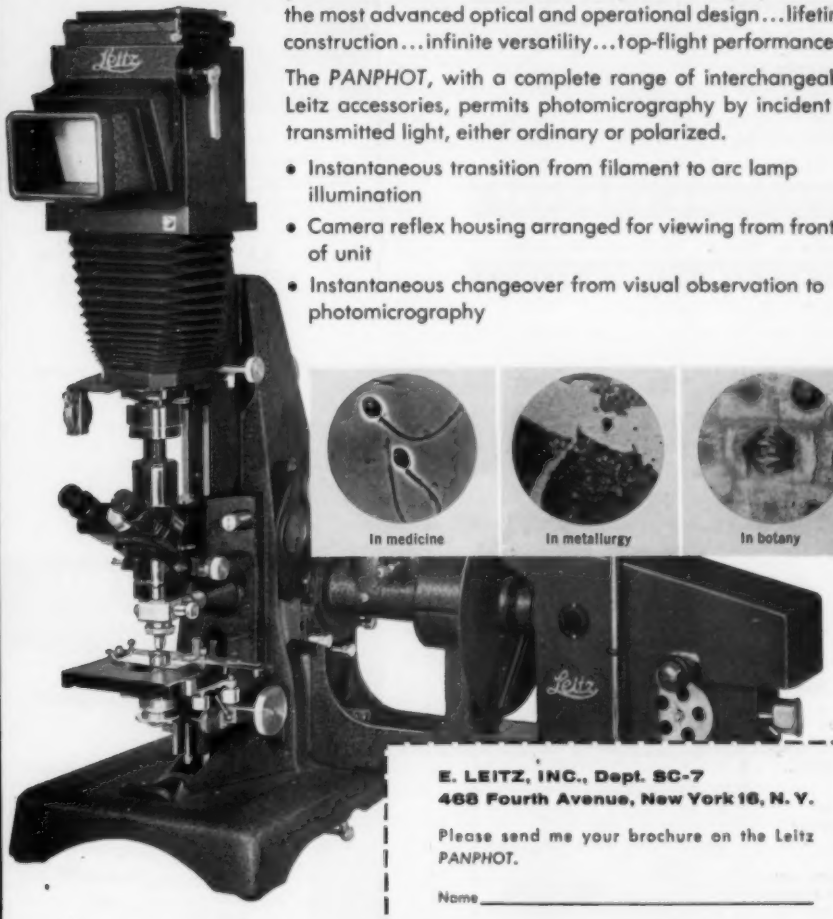
the Leitz **PANPHOT**

photomicrographic apparatus

Everything you expect from a really fine research instrument you will find in the Leitz *PANPHOT* photomicrographic unit—the most advanced optical and operational design...lifetime construction...infinite versatility...top-flight performance.

The *PANPHOT*, with a complete range of interchangeable Leitz accessories, permits photomicrography by incident or transmitted light, either ordinary or polarized.

- Instantaneous transition from filament to arc lamp illumination
- Camera reflex housing arranged for viewing from front of unit
- Instantaneous changeover from visual observation to photomicrography



In medicine In metallurgy In botany

E. LEITZ, INC., Dept. SC-7
468 Fourth Avenue, New York 16, N. Y.

Please send me your brochure on the Leitz *PANPHOT*.

Name_____

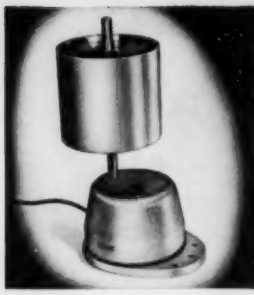
Street_____

City_____ Zone____ State_____

09355

E. LEITZ, INC., 468 FOURTH AVENUE, NEW YORK 16, N. Y.
Distributors of the world-famous products of Ernst Leitz, Wetzlar, Germany
LENSES • CAMERAS • MICROSCOPES • BINOCULARS

SCIENCE is published weekly by the AAAS, 1515 Massachusetts Ave., NW, Washington 5, D. C. Entered at the Lancaster, Pa., Post Office as second class matter under the act of 3 March 1879. Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢.



ELECTRIC KYMOGRAPH

Catalog No. 22275

RUGGED CONSTRUCTION ★ "SIX" SPEED CHANGES ★ SHAFT DIAMETER ⅜" ★ PRECISION CUT GEARS

STEEL BASE ★ POWERFUL INDUCTION MOTOR ★ SPINNING DRUM ★ LOW PRICE, $76.00

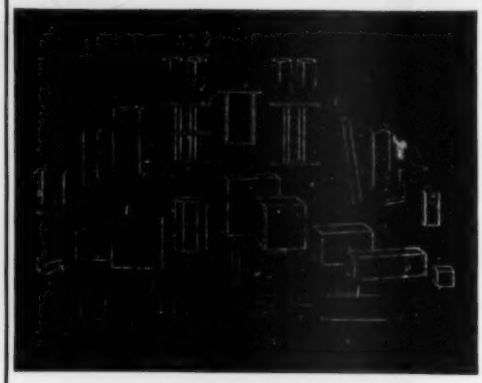
Write for additional information or Free Catalog

C. H. STOELTING COMPANY

Tambours, Stimulators, Time Markers, Power Supplies, Accessories available for "Electric"—"Ink" or "Smoke" writing.

424 N. HOMAN AVE., CHICAGO 24, ILL.

GLASS ABSORPTION CELLS made by KLETT



Makers of Complete Electrophoresus Apparatus

SCIENTIFIC APPARATUS

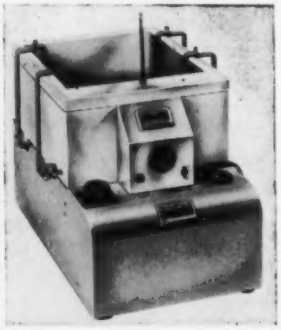
Klett-Summerson Photoelectric Colorimeters—Colorimeters — Nephelometers — Fluorimeters—Bio-Colorimeters — Comparators — Glass Standards—Klett Reagents.

Klett Manufacturing Co.

179 East 87 Street, New York, New York

ROTARY WATER BATH SHAKER

- Variable speed range 85 to 285 osc. per min.
- Temperature range 30°C. to 100°C. ± .5°
- Available for shaking various size flasks.



A shaking apparatus that is extremely useful for cultivating microorganisms under conditions of aeration and with more precise temperature control than is possible in an incubator. It is particularly valuable in obtaining bacterial growth curves.

Detailed information available upon request

NEW BRUNSWICK SCIENTIFIC CO.

PRECISION LABORATORY APPARATUS

P. O. BOX 606 • NEW BRUNSWICK, N. J.

KIPP & ZONEN

Specialized Scientific Instruments

Galvanometers, auxiliary apparatus and accessories

Recording Apparatus

Vacuum Thermocouples, Thermopiles and Radiatiometers

Solar Radiation Measuring Instruments

Engel Photo-Electric Colorimeter

Kipp Fluorometer

Kipp Flame Photometer

Vitne Spectrophotometer

Moll Microphotometers

Van Cittert Double Monochrometers

Mirror Spectrometer F/6 and F/3

Kipp & Zonen, of Holland, are world renowned manufacturers of precision laboratory equipment. Represented in the United States exclusively by the James G. Biddle Co.

Write for REVIEW 54-S

JAMES G. BIDDLE CO.

Electrical & Scientific Instruments

1316 ARCH STREET, PHILADELPHIA 7, PA.

29 July 1955, Volume 122, Number 3161

SCIENCE

AMERICAN ASSOCIATION
FOR THE
ADVANCEMENT OF SCIENCE

Board of Directors

GEORGE W. BEADLE, *President*
PAUL B. SEARS, *President Elect*
WARREN WEAVER, *Retiring President*
WALLACE R. BRODE
JOHN R. DUNNING
MARK H. INGRAHAM
PAUL E. KLOPSTEG
CHAUNCEY D. LEAKE
MARGARET MEAD
THOMAS PARK
LAURENCE H. SNYDER
PAUL A. SCHERER, *Treasurer*
DAEL WOLFLE, *Administrative Secretary*

DAEL WOLFLE, *Acting Editor*
CHARLOTTE V. MEETING, *Assistant Editor*

Editorial Board

MARK H. ADAMS — KARL LARK-HOROVITZ
WALLACE R. BRODE — EDWIN M. LERNER
BENTLEY GLASS — WILLIAM L. STRAUS, JR.

Editorial Staff

PEARL BOBIER, CATHERINE H. BORRAS, BEVERLY BUHNERKEMPE, MARY JANE DOUVILLE, OLIVER W. HEATWOLE, M. DALE HOOPER, ALICE KIRKPATRICK, YUKIE KOZAI, RUTH MCNEIL, ELLEN E. MURPHY, ROBERT V. ORMES, BETHSABE PEDERSEN, JACQUELYN VOLLMER

EARL J. SCHERAGO, *Advertising Representative*

SCIENCE, founded in 1880, is published each Friday by the American Association for the Advancement of Science at Business Press, Lancaster, Pa. Entered at the Lancaster, Pa., Post Office as second class matter under the Act of 3 March 1879.

SCIENCE is indexed in the *Reader's Guide to Periodical Literature*.

All correspondence should be addressed to SCIENCE, 1515 Massachusetts Ave., NW, Washington 5, D.C. Manuscripts should be typed with double spacing and submitted in duplicate. The AAAS assumes no responsibility for the safety of manuscripts or for the opinions expressed by contributors.

Change of address: The notification should reach us 4 weeks in advance. If possible, please furnish an address stencil label from a recent issue. Be sure to give both old and new addresses, including zone numbers, if any.

Annual subscriptions: $7.50; foreign postage, $1; Canadian postage, 50¢. Single copies, 25¢. Special rates to members of the AAAS. Cable address: Advancesci, Washington.

The AAAS also publishes THE SCIENTIFIC MONTHLY.

From Alamogordo to West Milton

On 16 July 1945 a little group in the desert dawn at Alamogordo witnessed the spectacular explosion that is commonly said to have ushered in the atomic age. Ten years and 2 days later another group, on a hot afternoon in West Milton, New York, watched the unspectacular closing of a switch that for the first time meant that American homes and industry were drawing electric current produced by an atomic reactor.

The power source was a turbine-generator driven by steam produced by a reactor designed as the prototype built for installation in the *Seawolf*, the second atomic-powered submarine to be constructed in this country.

Commercially, the event was of little importance. The Niagara Mohawk Power Company, which transmitted the power to its customers in northeastern New York, has a total capacity of 2,500,000 kilowatts; the General Electric reactor will add no more than 10,000 kilowatts. Nor was this the first time that power derived from a reactor had been used for lighting and other usual electric uses. At Arco, Idaho, in 1951, and again at Oak Ridge National Laboratory in 1953, atomic energy had been converted into electricity to run machinery and provide lighting for some of the buildings of those AEC installations. And in 1954 the Soviet Union claimed to be producing power from an atomic source of some half the capacity of the reactor at West Milton.

The importance of the event was symbolic rather than commercial. Rightly, the symbolic aspects were emphasized. The date chosen was the opening day of the Big Four "summit" meeting in Geneva. It occurred just 3 weeks before the opening, also in Geneva, of the International Conference on the Peaceful Uses of Atomic Energy. One of the first visible effects of the new power source was the illumination of a giant light bulb 42 inches high and 20 inches in diameter that the General Electric Company had built to commemorate the Diamond Jubilee of Edison's first incandescent lamp.

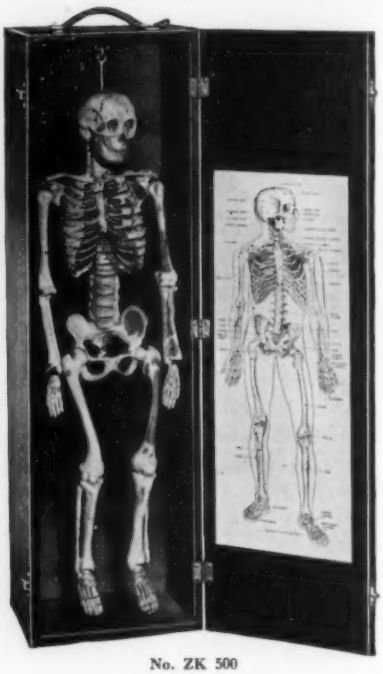
Although the commercial importance must be minimized, it is nevertheless true that factories and residences of the region are now drawing part of their electric energy from an atomic source. Heat produced in a nuclear reactor is transferred to a heat exchanger by liquid sodium; water converted to steam by the liquid sodium drives a turbine; electric current from the turbine-generator is passed through ordinary commercial channels to home lights, television sets, factory motors, traffic signals, and all the other electric devices of the age. The small scale power production of 18 July will grow to a much larger scale. A plant designed for the purpose will be supplying 60,000 kilowatts to the Pittsburgh area in a couple of years. At the West Milton ceremonies Lewis L. Strauss announced that American companies are ready to complete within the next 5 years six commercial atomic power plants with a total capacity of 765,000 kilowatts.

The use of atomic energy for everyday, peaceful purposes will in time become commonplace. The significance of West Milton, New York, on 18 July is that the process has already started.—D.W.

The Welch

SYNTHETIC MINIATURE HUMAN SKELETON

Only 26 Inches Tall



No. ZK 500

Accurately Scaled In Durable, Washable Synthetic Material

•

A Wooden Case And Plastic Cover Are Included

•

Especially Adapted For Elementary Work Where Economy Is Important

Designed for use in elementary biology courses, the miniature skeleton has proved of value in psychology, health, safety, first aid, and physical education courses. The low price enables the smaller schools to have at least one skeleton in the science department. The skeleton, with wooden case, weighs less than 20 pounds making it easy to carry from room to room.

The wooden case is constructed to permit the rotation of the skeleton within the case. An illustrated key card on the door identifies the principal bones. This arrangement permits a student to study the guide and skeleton together in order to more easily understand the skeleton. If desired, the skeleton can be removed from the case and hung in a more convenient place. The hook on the skull provides for attachment to other types of support.

Each skeleton includes an attractive wooden case, plastic skeleton cover, and an illustrated key card.

ZK500. MINIATURE SKELETON, Painted. The muscular origins are painted in blue, and the muscular insertions are in red on one side of the skeleton. Complete, with wooden case, plastic skeleton cover, and illustrated key card. **Each, $130.00**

ZK510. MINIATURE SKELETON. The skeleton is the same as ZK500, but the muscular origins and insertions are not painted. Many teachers prefer to paint the muscular insertions and origins themselves, and the surfaces of these skeletons readily accept paint. Complete with attractive wooden case, illustrated key card, and plastic cover. **Each, $115.00**

Full, Life Size Skeletons available at $190.00

W. M. WELCH SCIENTIFIC COMPANY

DIVISION OF W. M. WELCH MANUFACTURING COMPANY

ESTABLISHED 1880

1515 Sedgwick Street, Dept. E Chicago 10, Illinois, U. S. A.

Manufacturers of Scientific Instruments and Laboratory Apparatus

29 July 1955, Volume 122, Number 3161 SCIENCE

Men and Their Sciences

William Borberg

The terms *evolution of man* and *history of mankind* suggest grandiose pictures of what in reality has been an essentially disorderly cavalcade of fumbling and tumbling human beings. On the basis of what we may consider a clumsy approach to a science of environment, men long ago started more or less methodically to collect facts and knowledge on certain objects and events, forming generalizations about that knowledge and utilizing it. But at no moment did men concentrate on an over-all plan of what phenomena and experiences were most important to them for observation, experimentation, and thought. It is characteristic of their primitive egocentricity that they did not, until much later, see *themselves* as objects for scientific study.

These various collections of knowledge were, in the end, termed sciences, not clearly separated from philosophy or religion; they were often accepted dogmatically, obediently, on authority—an approach we now consider entirely inadmissible. Abstractions were made on abstractions, until now a few scores of specialists seem to be the only ones who really understand what it is all about.

It is this picture of *many* individuals and *many* fields of observation that I stress in the title of this article (*1*), knowing full well that the phrase "man and science" would have been nearer a best seller.

By insisting upon the *individuals* as *reality-units* for the problems dealt with here, I am in no way taking the position of philosophic solipsism. My individuals are real from womb to tomb, and they do interact; this means that each specimen reacts to acts of another specimen. Bring all the specimens you like into the picture: they tick in unison or in dissonance, but in reality they do not become groups, states, societies, peoples, communities, countries. The reification of such concepts—treating them as [though] factual units—obstructs the use of the natural-science methods. Of what help are probability methods in regard to "states" or "scientists," as one deals with one concrete Hitler or Einstein in one concrete situation?

To make my approach quite clear, I take examples that may seem cynical. First, there is no reason to believe that the most beautiful feeling, a mother's love, will not be unfolded unreservedly toward a child she believes to be her child, even if it is not. Mother-love ticks in her. Second, the child will respond along certain reaction lines. It ticks too but differently. To understand mother and child, one needs no group concept. Third, we know of no innate urge for reproduction in man. There is lust, nowadays beautified to romantic love. But there is no native knowledge of a connection between the birth of the child and the act of love hundreds of days before. It has to be discovered or taught.

Let me jump to another larger and entirely different field—that of conflicts between so-called "states"—to see how individuals "tick" there. We speak of "tensions," say, between Moscow and Washington. From the viewpoint of the natural sciences, what is this tension? An electric or other current or wave down through the earth from the Kremlin to the White House? or a black cloud over the arctic? No, there may be tensions in one or many individuals in the Kremlin and in other places, and in one or many individuals in the White House or the State Department, and so forth. But in between? Only communication—or the lack of it.

No useful purpose seems served, nor any theoretical scientific problem solved, by the interpretation of a very common and handy word *group* until it is no longer recognizable. Using the word *group* blurs the reality picture of the many *individuals* on whom we have to work to bring about change.

When one clings to the group concept, one induces people not only to feel but to think in such terms as *state, people,* or *nation*—which include individuals who take no part in decisions (for example, infants, men and women naturalized only yesterday by a piece of paper or by marriage; people ignorant of what is going on, and traitors).

When we, then, turn to the individuals, we find that neither the physical sciences nor the social sciences have exhaustively accounted for the human being or for his relationship to his environment. There are enough unknown variables to keep the most enlightened scientist humble. But this ought not to conceal the fact that it is both inspiring and frightening to see to what use men have put their sciences. I shall not expand on the horror aspects of this subject, for we are all more interested in finding out how the scientists might work for peace and cooperation. I want to emphasize, as Don K. Price of the Ford Foundation has pointed out, that long-range policy decisions are in effect often made by scientists and technicians meeting together and developing basic ideas for the solution of the next emergency situation, ideas that the politician then takes over (*2*).

To this may be added the fact that through their inventions and discoveries, scientists in certain instances do in effect, although unintentionally and without fully seeing it, predetermine what the statesmen will later decide. The physical sciences are becoming ever more influential in man's social living, as is seen in the impact of atomic science on our entire life.

This situation coexists with another: there are not enough scientists who are qualified for *research* work for the tasks ahead. If the *application* of the results of scientific research were properly organized all over the world, the insufficiency of the number of qualified scientists and technicians would be no less striking.

The decision on what research should be pursued is made, to a great extent not by the scientists concerned but by those who hold the purse-strings. In other words, the scientists compete for money favors, and each one does so without

Mr. Borberg is ambassador and permanent representative of Denmark to the United Nations.

considering whether a competing matter might not be more urgent or worthy.

Even in our time, the fields in which science has been developed have been selected with little systematic approach. For reasons of state, or the accidental occurrence of "genius," or a genius' chance interest in one field rather than another, or because of the interests of industries, some fields have been selected, some cultivated more than others.

This problem leads to a related one —whether certain scientific fields might be evaluated differently from what they now are. Many scientists maintain that they will have "nothing to do" with evaluation. This stand appears to confuse a mental condition essential to scientific thinking (namely, freedom of choice in research) with an evaluation or appraisal of such choice as less moral than a calculated rejection. These scientists have, as a matter of fact, by accepting their own field of research, made "value judgments" beyond this field.

The idea I want to suggest foremost may be expressed as the *scientific organization of science*. This sounds as if I were reaching for the stars. "Organization of science" rings of perfectionism; but, strange as it may sound, the method of bringing that "perfectionism" down to earth will consist in perfecting it by means of science itself. This is so because organization has become a field in which it is now possible to use scientific methods and scientifically acquired knowledge. Call in the specialists wherever possible! The creation of a *science organization service* would, therefore, be highly desirable. I shall return to this idea later.

Anyone who agrees that the scientific approach should be applied wherever applicable will, I believe, understand my desire to see scientifically acquired knowledge brought to bear on all our evaluations. This does not mean, though, that everything labeled "science" should be blindly adored. Some of the sciences as they are taught still have gross elements of "philosophy" in them. Part of the job will consist in making some existing sciences more scientific.

Initial planning must be very tentative and merely indicate the direction to be taken and the methods to be applied. Wherever scientific knowledge is insufficient, we must work with the mentality and morality of the true scientist—deferring judgment. That scientific methods are superior to political ones does not mean that we can dispense with the latter, or that we want a "dictatorship of scientists." There is much know-how in politics that scientists ignore and are now unable to replace with scientific skill. But, on the other hand, we must select as a field of great importance the progressive use of science in preparing political decisions. It seems fitting here to suggest that scientists everywhere try to induce their respective state parliaments to follow the example of the Parliamentary and Scientific Committee of Great Britain, which is alert to the relationships between science and politics. One day committees such as this one may then "compare notes" supranationally in conferences.

Some scientists fear that organization will deprive them of the leisurely dream world where the subconscious suddenly emits an inspiration that solves a hard problem or opens up wide new horizons. On the contrary, better organization must mean more freedom for creativity. Organization is not regimentation. Every organization must fit the purposes that it is intended to serve. (Military organization means regimentation within certain fields.) Organization means attitudes in individuals that make them function effectively. The organization of scientific work must, therefore, be suited to the scientific mentality, growing out of its very nature, and must aim at increasing in scientists their curiosity, inspiration, and "reverie." The atomic scientists who formed a team during World War II also continued afterward in organized research suited to their field and mentality. This field now appears to all concerned obviously suited for teamwork, but there are other fields the evaluation of which is likewise obviously suited for organization in a similar way.

The first field is *peace*. It is insanity on the part of a species to commit suicide, and we have reached the stage of military preparations for war that threatens race suicide. From a biological viewpoint, war has ceased to be selective and has become merely mass destruction. We not only have perfected the atom bomb and the hydrogen bomb, we also have G-gas; air-borne crop-killing germs can starve an entire population. This approach to the question of peace is thus, to my mind, entirely scientific. By this I mean that we are not dealing with war and peace on an abstract, humanitarian basis; nay, the motive is founded on a science—biology—which does not exclude other motives, such as the certainty that scientists would be killed by the thousands.

In the area in which peace-and-war decisions are made, generalizations, otherwise useful in the sciences, are very dangerous. Since these decisions are, in fact, made by a limited number of human beings (not by "the people" or "the state"), the best approach would be operational research on these individuals, with immediate application of findings. We would have to study closely the leaders who make the decisions, find means to remove the unsuited ones from power or prevent them getting power, and give the others all the necessary available knowledge. We must understand that, at each important political nerve center, it might be necessary to have not one scientist but 50 or more. During the 1954 Danube catastrophe, American and Soviet soldiers cooperated to stem the floods. May not the "soldiers of science" be permitted to contribute to the prevention of the much greater catastrophe of a world war?

A field such as the organization of science in the service of mankind seems to be a common interest in which East and West might meet in an endeavor to join hands for a positive peace program. (After all, Stalin admitted in an interview years ago that in case of a conflict between ideology and science, it would be ideology that would have to give way.) *In science fanaticism has no place.* The enormous sums spent by the Soviet Union on science, the ever-increasing number of scientifically trained men that they produce, must create to some degree a mentality with many elements common to that of our own scientists. Let us then face one fact: an affirmative answer from the Communist countries would be met with suspicion in many Western minds, but so would a negative one, and no magic formula will allay suspicion. But it seems worth trying to humanize the ideologies and, by such a joint enterprise as the scientific organization of science, make the issues more realistic—this is, more scientific.

Another obvious field for scientific study must be the scientists themselves. *Scientist* is a mere word denoting a certain aspect in a human being; if a scientist relinquishes scientific knowledge, applies other than scientific methods, meets problems in an emotionally upset state instead of open-mindedly, he is not, at that moment acting as a scientist. On the other hand, a man who does not have a title of professor or doctor may, when faced with a given problem, think entirely scientifically.

The mere fact that an individual is, thus, classified as "scientist" cannot free him from obligations of responsibility toward other human beings. Some scientists feel that, if they work hard and honestly without extra pay for overtime, they are not to be blamed for the consequences of their research, and that no one else should decide what they should study. However, their food, shelter, clothing, and so forth, are produced by others. "Science for its own sake" is, therefore, morally comparable to selfish dictatorship. When this is said, it must at once be added that no interference by incompetents in the scientific fields

should be tolerated. We cannot admit that some person highly "advertised"—like a Hitler, or a Mussolini, or a body endowed with authority—should know better than the scientists what fields should be cultivated. A better understanding of the value of pure research would result if scientists lead in the selection of fields. The scientists do not seem always to remember that their methods are far superior to political methods; they have every right to meet a challenge from political sides in a courageous spirit. But they must themselves take up the selection of fields and their cultivation as a *scientific problem.*

However, the proper place of science is not as an organ of *power* like the political, the administrative, or the judiciary. It is an element of *influence,* and we may well imagine this element organized in every "good" society on equal footing with the other three. Truth might well deserve this position anywhere. If this is agreed upon, there will be greater interest in finding out not only how we can organize scientific research and the application of results but also what can be done to improve the conditions of scientists. I am not thinking simply of their low salaries or unsatisfactory working conditions. I think also of such problems as how to educate children to think scientifically; how to select the children best fitted for scientific research and how to train them; the mentality and outlook of the scientists, spirit of teamwork, organizational understanding on local, national, and global levels; how to free scientists from much tedious work. Can geniuses be discovered—and what conditions will insure their maximum contribution? Can we, by artificial means, such as dehumidification of the air they are breathing, more oxygen, drugs, electric treatment, nourishment, hypnosis, or secretarial help, increase the total output of such brains? Often solutions to problems are said to occur to a person during sleep. Can something be done for such minds to produce more fertile sleep? I have often met the belief that the history of science proves that genius needs difficulties to overcome, needs poverty or conflict. Is this scientifically true? (*3*).

It is further of interest to find out why scientists select the problems they prefer. Are the selections due to their "personality," or are they accidental? What are the characteristics of scientific observation and thinking from a biopsychological point of view? What is going on in a human being when he is trying to penetrate a problem scientifically? What are we doing when we are thinking? Have we an instinct or propensity for thinking? And if so, what can we do to bring it into play at the right time and more and more? Many observations have been collected on the art of thinking, but these appear mostly in the books of self-made men and barely scratch the surface.

I shall make no mention of all the technical aspects of the scientist's life; fortunately a certain interest is taken in them by UNESCO and other organizations and institutions.

From the organizational point of view, the attitudes of scientists in regard to their tasks is of fundamental importance. Anthropologists, for example, commonly recognize the vast area in which their methods are applicable. They have a high code of ethics, which other scientists may well study. But they seem to think that it is all right to leave the question of where their methods and knowledge ought to be applied to each individual's own evaluation. From the point of view presented here, another outlook would be desirable. It is not enough that each anthropologist acts morally and that he accepts full responsibility for the foreseeable effects of the application of his methods and of his decision on where he would accept or refuse work. It is difficult but possible to develop an approach to the problem of selecting the fields and of deciding priorities that would approach making a science of the process of evaluation, instead of just being rigidly scientific and efficient within a more or less fortuitously adopted field.

The science of human relationships and human organization have grown to such an extent that they are being applied in practical life, in government, in industry, and in many other fields. It seems to me that the problem of organizing science might, with hope for success, be approached by means of what is known scientifically concerning organization. Scientists should themselves bring about their consensus, good will and organizational attitudes for active planning and cooperation in the selection of fields and their study. It is, I know, impossible to put up one unalterable menu, but this is the case in all existing sciences. We have to work on a tentative basis and always test our evaluations and hypotheses by means of the latest discoveries in any science within the framework of the general view.

More anthropologists are required. We should try to utilize the qualified ones we have for the study of the most important tasks, in the first place, *peace,* and concomitantly, the *organization of science* and the *mentality of the scientists.*

But there are other obvious fields, for instance, *bioeconomics.* We would have to start with man as the other natural sciences describe him, in a setting that may well be called ecological. In determining whether a demand should be met, the other sciences would contribute their knowledge. Instead of turning to statistics of actual consumption or production, economics would be based on the biological stages through which man passes. Economic measures would have to fall in line with the knowledge the different sciences can bring to bear on the problem. Therefore, the ultimate aim in economics would tend to be living at the optimum of the individual's biological capacity when he is functioning in a mentally and physically healthy way. In the present stage of our history, economic policies cannot avoid being influenced by elections, or whatever propaganda form or ideological or other pressure is dominant in the state concerned.

If it were true that cigarette smoking makes one liable to lung cancer (and I do not pretend to know), it can hardly be good bioeconomics to ease taxation on cigarettes; nor can the production of destructive arms be sound bioeconomics, however necessary it may be from a military point of view in a given world situation.

Further, an *interdisciplinary team approach* to economic problems is desirable. It may be short-sighted to eliminate dangerous insects if at the same time we kill the bees necessary for our food production. And it is of mixed advantage to be able to exterminate wild rabbits by means of a microbe, if by so doing we kill the rabbits that are raised for eating.

A science of work is indicated; it cannot be said to exist. Experiments on work, fatigue, and so forth, are carried on in physiological laboratories and elsewhere, but work plays such a role in the lives of human beings that it seems to deserve a science of its own.

Politics is another important field. Political terms are not precise expressions for clear concepts. They are often stereotypes, appealing to our emotions and not describing facts. A scientific study of the concepts used in politics, publicly well disseminated, examining and explaining what these concepts really represent (that is, human individuals in their interplay) might fundamentally affect internal, as well as external, policies in many countries. *Semantics* must come to play a greater role. Political *descriptions,* like other descriptions, must indicate what the symbols symbolize—that is, what realities they involve.

Another field of tremendous importance is *mental health* (*4*). There seems to be no human problem to which the findings of the mental-health expert would not contribute substantially, not merely to the wholesome personal happiness of the individuals, but also to the interplay that brings more and better results for all concerned.

But it must always be remembered that

selection of a field is a limitation in outlook. From the point of view of mental health, name-calling is bad, it creates resistance, hostility, aggressiveness. But the mental-health experts must understand that in politics name-calling is not simply a means of releasing one's emotions or hurting the emotions of the other fellow. It might unfortunately be used to stir effectively the emotions of constituents so that one can win an election or a following, and this may for other reasons have highest priority.

Sometimes organization would simply mean an extension of work already commenced or imitation of organization tried elsewhere. Some work is already done in a limited way, for instance by the Council of Scientific Unions, which surely does not have all the money it deserves. UNESCO has also tackled the question of scientific work, but more as liaison than as organized planning, and its budget is ridiculously small compared with what is needed. Furthermore, decisions in the general conference of UNESCO are primarily taken by people in their role as government representatives, although they may be scientists.

It may further be very desirable if other countries would emulate for instance the *scientific mission* of the United Kingdom in Washington. To begin with, smaller states may be content to have one science attaché.

If we start the trend for deliberate scientific development in organization of science with a nucleus (a special team consisting of experts in, for instance, social psychology, sociology, applied anthropology, human organization, semantics, history, physics, and a few others), we may safely leave to them to add to the nucleus, as needed, experts in other fields. What is essential is that decisions on the entire work be taken by men and women who are science-minded and have the vision and understanding of the task.

In many countries institutions exist free to choose scientific fields; such institutions, for example, as government funds under control of scientists or big foundations created by private individuals, and so forth, particularly in the United States. Such funds and foundations might be of great help, especially in the preliminary stages, and best if they acted in concerted effort.

Anyway the foundations should be consulted and included in planning for this type of science organization. The contributions of foundations to the organization of fields and the cross-fertilization of thought have been tremendous, and I am sure much could be learned from the experience of foundations. They would undoubtedly warn us against trying to swallow too much at a time. So would I. But I think that we have a safety valve against speed in the lag that always results from resistance to disturbances of a quiet life, communication difficulties, and the conservatism of opinions.

Apart from contributions from states and other units (without strings attached), it would be worth while to examine whether the *generosity of private persons and institutions* is used in the best way. It seems now a matter of chance what is chosen as an object for generosity. Would it not be feasible to have a well-advertised council to which prospective donors could turn for advice regarding the fields most in need?

Such a council evidently would have to be part of, or in close connection with the science organization service, the title of which would, at the same time, indicate that it would function only as a service. The process would in all respects be a self-perpetuating one, thrashing out fields and programs, testing their basis, organizing for research and application, simultaneously with discoveries and inventions leading to new lines of direction, always scientifically oriented and not based on power decisions. The program envisaged may well be furthered by an organized *exploitation of inventions* in the service of organization. There are cases where scientists have put their inventions at the disposal of research. This idea might be further developed to attract inventors as donors, for instance, via life-annuities.

The scientific organization of science would lead more and more *people to be research-minded*. Gardner Murphy, Dorwin Cartwright, and Jeromes Bruner state that "people who have once learned to think in research terms are never likely again to go back to the quasi-moralistic, the acrimonious, or the horse-trading approach to social problems" (*5*). This is not the least important thing; the research-minded approach is mentally healthy.

The foregoing discussion is, of course, a very limited sketch of what ought to be done and a rather hazy picture of certain aspects of the human situation out of which we have to draw the elements for scientific organization of the application of scientific methods and scientifically acquired knowledge. Due acknowledgment to others for similar thoughts (*6*) has been excluded by time and space limitations, and experiments going on, organization already in existence, left unmentioned. But I feel convinced that there is among the scientists themselves sufficient healthy cooperative good will to aim at teamwork for enormous expansion in the fields indicated.

In humility but with eagerness the scientists would thus develop their sciences toward the best possible aims, so that all would feel that men and their sciences belong together so intimately that we were one unit (rather than billions of divergent individuals), mankind, progressing in an ever more orderly way.

References and Notes

1. Based on an address given at the Fifth International Congress on Mental Health, Toronto, Canada, 17 Aug. 1954. The original and full text will appear in the Proceedings of the Congress.
2. D. K. Price, *Government and Science* (New York, 1954).
3. Certain studies are in progress in some of the fields, but they are relatively few and limited—nothing on a world-basis, either in regard to research or to applied science.
4. See my appeal "On active service for peace," *Bull. World Federation for Mental Health (London)*, Aug. 1950; also my "On methods of the social sciences in their approach to international problems," *Am. J. Psychiat.* 107, No. 9, Mar. 1951.
5. *J. Social Issues* 3, 65 (1947).
6. See, for example, H. von Euler-Chelpin, "Place of science in society today," *Sci. Monthly* 79, 365 (1954).

A bitter paradox underlies many aspects of our era. The marvelous achievements of science are being used to destroy the civilization which science has achieved. Learning has been directed to the obliteration of its own temples. The great ideals of human liberty are led to the sacrifice by those who would preserve them. But of all the paradoxes around us none is more disconcerting than the fact that we, living during one of the greatest upheavals of recorded history, have so little understanding of the historical significance of our own times.—FELIX MORLEY.

Steps in the Oxidation of Indoleacetic Acid

Peter M. Ray and Kenneth V. Thimann

During the oxidation of indole-3-acetic acid (IAA) by an enzyme obtained from cultures of the fungus *Omphalia flavida* (*1*), the ultraviolet absorption spectrum was studied (*2*). At most wavelengths, the change in optical density is not proportional to disappearance of the substrate (IAA), as was shown by following the IAA simultaneously with the Salkowski color reaction (*3*). The spectrum continues to change after the IAA has been exhausted, indicating that the initial product of the reaction undergoes further transformation.

At the wavelengths 261 and 231 mμ however, the change in optical density is almost exactly proportional to substrate disappearance and practically ceases just when the IAA has been consumed. These must, therefore, be wavelengths at which products *A* and *B* of a reaction sequence,

$$\text{IAA} \rightarrow A \rightarrow B,$$

have identical molar extinction coefficients, ε. Thus the second reaction occasions no change in absorption, and the change in optical density at 261 mμ measures the conversion of IAA to (*A* + *B*).

At 272 mμ, optical density remains nearly constant during the first few minutes of the reaction, then falls with increasing speed until the IAA is exhausted. It continues to fall without a break at that time and thereafter declines along a first-order path (Fig. 1). Hence, 272 mμ is a wavelength at which *A* and IAA have the same ε, so that change in optical density measures conversion of (IAA + *A*) to *B*, which has a smaller ε. At other wavelengths the absorption changes throughout the reaction period, but the time-course curves show obvious breaks in slope at the time when absorption begins to fall at 272 mμ and when it ceases to rise at 261 mμ.

The rate of change of optical density at 261 mμ is strictly proportional to the enzyme concentration (Fig. 1) and is strongly inhibited by $10^{-3}M$ HCN, $1.1M$ HCHO, or by bringing the *p*H to 2.0 or 7.0, as is the over-all oxidation. In contrast, the rate of change at 272 mμ is very little affected by these treatments (but accelerated at *p*H 2), provided that they are applied after the IAA has disappeared. The rate is also unaffected by varying the enzyme concentrations at that time (Fig. 1).

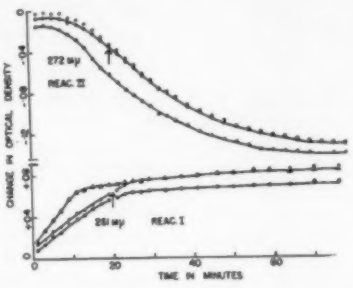


Fig. 1. Effect of enzyme concentration on reactions I and II (○, ●, 0.03 ml of enzyme; △, 0.06 ml of enzyme; ↑, 0.03 ml of enzyme added to ●). Change in optical density at 261 mμ and 272 mμ during the oxidation of 0.14 μmole of IAA in 3.1 ml of $0.005M$ citrate buffer at *p*H 3.7, containing the amounts of *Omphalia* enzyme preparation (dialyzed culture medium) shown, and 0.02 μmole of H_2O_2. The break in slope at 261 mμ occurs at the time the IAA is exhausted. The enzyme concentration is doubled at zero time in △ and just before the IAA is exhausted in ●. Optical densities are corrected for change caused by the addition; light path 1 cm.

We deduce that the reaction IAA ⟶ *A* is catalyzed by the enzyme, while *A* ⟶ *B* is nonenzymatic. Removal of oxygen prevents the conversion of IAA to *A* but does not inhibit *A* ⟶ *B*, which thus appears to be nonoxidative. This second reaction is acid-catalyzed (Fig. 2), with velocity constant approximately

$$k_1 = (3.6 \times 10^{-2} + 35\ [\text{H}^+]M^{-1})\ \text{min.}^{-1}$$

at 27°C. Its first-order kinetics (Fig. 2) make it unlikely that two separate products of enzyme action from a scheme

$$\text{IAA} \begin{cases} \nearrow A_1 \rightarrow B_1 \\ \searrow A_2 \rightarrow B_2 \end{cases}$$

are present. From the kinetics it is also improbable that a dismutation, dimerization, or polymerization of *A* is occurring. However, it is possible that *A* decomposes by two independent pathways:

$$A \begin{cases} \nearrow B_1 \\ \searrow B_2 \end{cases}$$

Yet the absorption at 261 mμ remained constant and the final absorption spectrum was the same when the temperature was varied from 5° to 37°C and when the *p*H was varied from 2 to 6.5 during the second reaction: both factors vary the rate of this reaction enormously and might well affect differentially two such independent decompositions. Although the oxidation product is known (by chromatography) to consist of more than one substance, it is not certain at present whether this is the result of the second reaction or of changes during the working-up procedure.

The absorption spectrum of *A* can be estimated in two ways: (i) from the initial rate of change of optical density (when the second reaction is very slow), or (ii) from the absorption at the time the IAA has just disappeared (by subtracting absorption caused by *B*, which is calculated from change in optical density at 272 mμ). Figure 3 shows an estimate obtained by the first method.

The substance(s) *B* (ultraviolet spectrum shown in Fig. 3) is believed to be an oxindole derivative (*4*), and the

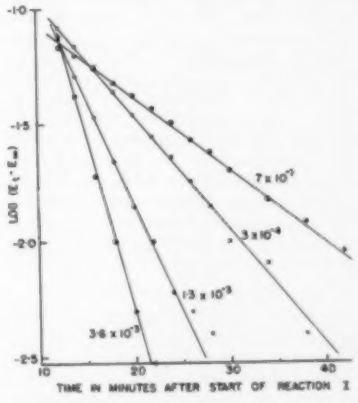


Fig. 2. H^+ catalysis of reaction II. First-order decline in optical density at 272 mμ after the disappearance of IAA, as a function of $[H^+]$. Ordinate shows log of difference between optical density at time *t* and final optical density. The unbuffered solution (3.1 ml) contained 0.135 μmole of IAA, 0.02 μmole of H_2O_2, and enzyme; it was adjusted to *p*H 3.5 with $0.01M$ HCl. Just after the IAA had disappeared, 12 min after the start of the reaction, the $[H^+]$ was altered by addition of HCl (lower two curves) or sodium phosphate buffer (upper curve). Final $[H^+]$ in moles per liter is given for each curve; light path 1 cm.

Professor Thimann is on the staff of the Biological Laboratories, Harvard University, Cambridge, Mass. Dr. Ray is a member of the Society of Fellows, Harvard University.

stoichiometry is fulfilled by 3-methyldioxindole (III). The spectrum of the intermediate *A* is not that of indole-3-aldehyde, 5- or 7-hydroxyindoleacetic acid (*5*), or any acetophenone derivative for which we have information. It is rather similar to that of 11-hydroperoxytetrahydrocarbazolenine (*6*); this compound was considered by Witkop and Patrick (*7*) to be a model for the intermediate in the biological conversion of tryptophan to formylkynurenine (*8*). The hydroperoxide (*7*) opened by an acid-catalyzed rearrangement to give a cyclic lactam of δ-*o*-aminobenzoylvaleric acid, analogous to formylkynurenine. A similar hydroperoxide (II) could be formed by the (enzymatic) addition of O_2 to, and loss of CO_2 from, the isoindole form (Ib) of IAA, but this would probably not open between the 2- and 3-carbons, because the C-H bond at C-2

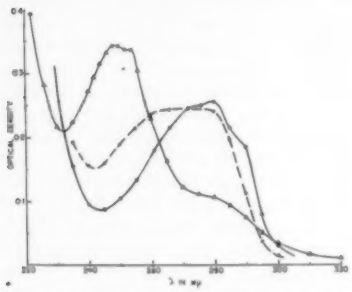
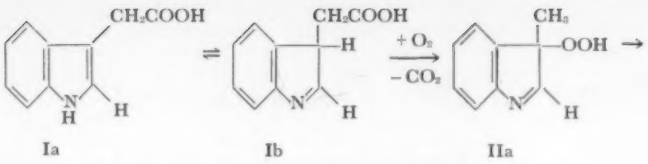
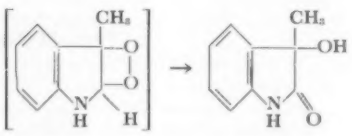


Fig. 3. Ultraviolet absorption spectra of IAA (●), the final product *B* (△) after enzymatic oxidation, and the intermediate *A* (broken line). The latter shows the spectrum that would have resulted if the changes in optical density during the first 4 min of the reaction, at each wavelength, had continued proportionate to the disappearance of IAA until this was exhausted. Three milliliters of $4.5 \times 10^{-5}M$ IAA in 0.005*M* citrate buffer at *p*H 3.7, containing enzyme and 0.01 μmole of H_2O_2, against blank containing enzyme and buffer; light path 1 cm.



Ia Ib IIa



IIb III

would more readily lose electrons. Instead, 3-methyldioxindole (III) would be formed. Side reactions involving formation of indoxyl derivatives and/or dimerization might be anticipated from the reactions of 11-hydroxytetrahydrocarbazolenine (*9*). These are speculations only, but they are interesting in view of the possible relationship of our observations to the persistent problem of identifying the intermediate between tryptophan and formylkynurenine (*10*).

The reaction sequence described here is strikingly similar to that which has been found for the oxidation of uric acid by uricase (*11*) or by peroxidase (*12*). Uric acid is converted enzymatically to an intermediate, which decomposes by nonenzymatic reactions into the final products (allantoin, alloxan, or other substances), and thus ultraviolet absorption continues to change for some time after the uric acid has disappeared. In this case there is other than spectroscopic evidence for the existence of an intermediate (*13*).

It is of interest to mention that the oxidation of IAA by horseradish peroxidase in the presence of H_2O_2 appears to follow kinetics similar to those described here. Furthermore, the spectrum of the final product is almost identical with that of *B* (Fig. 3). This suggests that the reactions studied here may occur generally in the destruction of IAA by higher plants.

References and Notes

1. L. Sequeira and T. Steeves, *Plant Physiol.* **29**, 11 (1954).
2. This work was carried out during the tenure of a National Science Foundation fellowship by one of us (P.M.R.). Support is also acknowledged from the Committee on Growth of the National Research Council, acting for the American Cancer Society, and from the National Science Foundation.
3. S. A. Gordon and R. P. Weber, *Plant Physiol.* **26**, 192 (1951).
4. B. Stowe, P. Ray, K. V. Thimann, *Rapp. et Commun. 8e Congr. Intern. Botan. Paris* (1954), sect. 11, p. 151; also supplementary volume, in press.
5. These last two compounds are indeed decomposed under the same conditions but at so slow a rate that they are in any case excluded from being intermediates.
6. R. J. S. Beer, L. McGrath, A. Robertson, *J. Chem. Soc.* 1950, 2118 (1950).
7. B. Witkop and J. B. Patrick, *J. Am. Chem. Soc.* **73**, 2196 (1951).
8. W. E. Knox and A. H. Mehler, *J. Biol. Chem.* **187**, 419 (1950).
9. B. Witkop and J. B. Patrick, *J. Am. Chem. Soc.* **73**, 2188 (1951).
10. C. E. Dalgleish, *Quart. Revs. Chem. Soc. (London)* **5**, 227 (1951); A. Ek *et al., Experientia* **8**, 36 (1952).
11. E. Praetorius, *Biochem. et Biophys. Acta* **2**, 602 (1948).
12. K. G. Paul and Y. Avi-Dor, *Acta Chem. Scand.* **8**, 637 (1954).
13. R. Bentley and A. Neuberger, *Biochem. J. London* **52**, 694 (1952).

The scientist should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biased by appearances; have no favorite hypothesis; be of no school; in doctrine have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities be added industry, he may indeed hope to walk within the veil of the temple of nature.—MICHAEL FARADAY.

News of Science

Scientists Appeal for Abolition of War

In an effort to make quite clear to the world what will happen in the event of nuclear warfare, nine eminent scientists have submitted a statement to the United States, the Soviet Union, Great Britain, France, Communist China, and Canada, which are the countries that have acquired or will eventually acquire nuclear armaments. According to Bertrand Russell, who released the statement, the appeal grew out of a broadcast that he gave in London last December on the peril of nuclear weapons. The late Albert Einstein nominated Russell to draft the statement, the full text of which follows.

"In the tragic situation which confronts humanity we feel that scientists should assemble in conference to appraise the perils that have arisen as a result of the development of weapons of mass destruction, and to discuss a resolution in the spirit of the appended draft.

"We are speaking on this occasion, not as members of this or that nation, continent or creed, but as human beings, members of the species man, whose continued existence is in doubt. The world is full of conflicts, and, overshadowing all minor conflicts, the titanic struggle between Communism and anti-Communism.

"Almost everybody who is politically conscious has strong feelings about one or more of these issues. But we want you, if you can, to set aside such feelngs and consider yourselves only as members of a biological species which has had a remarkable history, and whose disappearance none of us can desire.

"We shall try to say no single word which should appeal to one group rather than to another. All, equally, are in peril, and if the peril is understood, there is hope that they may collectively avert it.

"We have to learn to think in a new way. We have to learn to ask ourselves not what steps can be taken to give military victory to whatever group we prefer, for there no longer are such steps; the question we have to ask ourselves is, what steps can be taken to prevent a military contest of which the issue must be disastrous to all parties?

"The general public, and even many men in position of authority, have not realized what would be involved in a war with nuclear bombs. The general public still thinks in terms of the obliteration of cities. It is understood that the new bombs are more powerful than the old and that, while one A-bomb could obliterate Hiroshima, one H-bomb could obliterate the largest cities, such as London, New York, and Moscow.

"No doubt in an H-bomb war great cities would be obliterated. But this is one of the minor disasters that would have to be faced. If everybody in London, New York, and Moscow were exterminated the world might, in the course of a few centuries, recover from the blow. But we now know, especially since the Bikini test, that nuclear bombs can gradually spread destruction over a very much wider area than had been supposed.

"It is stated on very good authority that a bomb can now be manufactured which will be 2500 times as powerful as that which destroyed Hiroshima.

"Such a bomb, if exploded near the ground or under water, sends radioactive particles into the upper air. They sink gradually and reach the surface of the earth in the form of a deadly dust or rain. It was this dust which infected the Japanese fishermen and their catch of fish.

"No one knows how widely such lethal radioactive particles might be diffused, but the best authorities are unanimous in saying that a war with H-bombs might quite possibly put an end to the human race.

"It is feared that if many H-bombs are used there would be universal death—sudden only for a minority; but for the majority a slow torture of disease and disintegration.

"Many warnings have been uttered by eminent men of science and by authorities in military strategy. None of them will say that the worst results are certain. What they do say is that these results are possible, and no one can be sure that they will not be realized.

"We have not yet found that the views of experts on this question depend in any degree upon their politics or prejudices. They depend only, so far as our researches have revealed, upon the extent of the particular expert's knowledge. We have found that the men who know most are the most gloomy.

"Here then is the problem which we present to you, stark and dreadful and inescapable: Shall we put an end to the human race: Or shall mankind renounce war? People will not face this alternative because it is so difficult to abolish war.

"The abolition of war will demand distasteful limitations of national sovereignty. But what perhaps impedes understanding of the situation more than anything else is that the term *mankind* feels vague and abstract.

"People scarcely realize in imagination that the danger is to themselves and their children and their grandchildren, and not only to a dimly apprehended humanity. They can scarcely bring themselves to grasp that they, individually, and those whom they love, are in imminent danger of perishing agonizingly. And so they hope that perhaps war may be allowed to continue, provided modern weapons are prohibited.

"This hope is illusory. Whatever agreements not to use H-bombs had been reached in time of peace, they would no longer be considered binding in time of war, and both sides would set to work to manufacture H-bombs as soon as war broke out, for if one side manufactured the bombs and the other side did not, the side that manufactured them would inevitably be victorious.

"Although an agreement to renounce nuclear weapons as part of a general reduction of armaments [H. J. Muller makes the reservation that this be taken to mean 'a concomitant balanced reduction of all armaments'] would not afford an ultimate solution, it would serve certain important purposes.

"First: Any agreement between East and West is to the good insofar as it tends to diminish tension.

"Second: The abolition of thermonuclear weapons, if each side believed that the other had carried it out sincerely, would lessen the fear of a sudden attack in the style of Pearl Harbor, which at present keeps both sides in a state of nervous apprehension.

"We should therefore welcome such an agreement, though only as a first step.

"Most of us are not neutral in feeling, but, as human beings, we have to remember that, if the issues between East and West are to be decided in any manner that can give any possible satisfaction to anybody, whether Communist or anti-Communist, whether Asian or European or American, whether white or black, then these issues must not be decided by war. We should wish this to be understood, both in the East and in the West.

"There lies before us, if we choose, continual progress in happiness, knowledge and wisdom. Shall we, instead, choose death because we cannot forget our quarrels? We appeal, as human beings, to human beings: Remember your humanity, and forget the rest. If

you can do so, the way lies open to a new paradise; if you cannot, there lies before you the risk of universal death.

"We invite this congress, and through it the scientists of the world and the general public, to subscribe to the following resolution.

"In view of the fact that in any future world war nuclear weapons will certainly be employed, and that such weapons threaten the continued existence of mankind, we urge the governments of the world to realize and to acknowledge publicly that their purpose cannot be furthered by a world war, and we urge them, consequently, to find peaceful means for the settlement of all matters of dispute between them." (Signed)

PERCY W. BRIDGMAN (Harvard University, foreign member of Royal Society, London, Nobel prize for physics)

ALBERT EINSTEIN (Institute for Advanced Study, Nobel prize for physics)

LEOPOLD INFELD (University of Warsaw, member of Polish Academy Sciences, joint author with Einstein of *The Evolution of Physics* and *The Problem of Motion*)

HERMAN J. MULLER (formerly a professor in Moscow, India, and so forth, now at Indiana University; Nobel prize in physiology and medicine)

CECIL F. POWELL (Bristol University, England; Nobel prize for physics)

JOSEPH ROTBLAT (professor of physics in the University of London, at St. Bartholomew's Hospital Medical College)

BERTRAND RUSSELL

HIDEKI YUKAWA (Kyoto University; Nobel prize for physics)

JEAN FRÉDÉRIC JOLIOT-CURIE (University of Paris, Nobel prize for chemistry)

A week later, on 15 July, at the end of the 5th annual Lindau, Germany, conference, 18 Nobel prize winners signed the following statement.

"We, the undersigned, are scientists of different countries, different races, different denominations and different political convictions.

"The only thing that binds us—on the surface—is the Nobel prize which we have the honor to possess. It was with enthusiasm that we became servants of science. We believe it a way to happy life. We are terrified to see that this science gives mankind instruments to destroy itself.

"Full use in wartime of all weapons available would contaminate this earth with radiation sufficient to destroy entire nations.

"This kind of death can hit the neutrals as well as the combating parties should a war break out between the major powers.

"Who can guarantee that such a war would not develop into such a deadly fight?

"Thus, a nation which engages in a deadly war invites disaster for itself and endangers the whole world.

"We do not deny that perhaps today fear of these lethal weapons maintains peace.

"But in spite of this, we believe that a government betrays itself by thinking that fear of these weapons will prevent wars for a long time. Fear and tension have often led to wars. We also believe it is wrong to speculate that smaller conflicts would continue to be solved by the use of conventional weapons.

"In extreme danger, no nation will refrain from using a weapon which science can help to produce.

"All nations must come to the conclusion to refrain from the use of power as an ultimate means of statesmanship. If they won't do this they will cease to exist." (Signed)

KURT ADLER, Germany
MAX BORN, England
ADOLPH BUTENANDT, Germany
ARTHUR H. COMPTON, United States
GERHARD DOMAGK, Germany
HANS VON EULER-CHELPIN, Sweden
OTTO HAHN, Germany
GEORGE DE HEVESY, Denmark and Sweden
WERNER HEISENBERG, Germany
RICHARD KUHN, Germany
FRITZ A. LIPMANN, United States
PAUL MUELLER, Switzerland
HERMANN J. MULLER, United States
LEOPOLD RUZICKA, Switzerland
FREDERICK SODDY, England
HERMANN STAUDINGER, Germany
WENDELL M. STANLEY, United States
HIDEKI YUKAWA, Japan

Traveling Science Libraries for Small High Schools

To assist high-school students to learn more about science, and to interest some of them in becoming scientists, the AAAS will start in the fall a program of sending traveling science libraries to a selected list of small high schools. Plans were developed cooperatively with the U.S. Office of Education and the National Science Foundation, which has made a grant to the Association to cover the costs. (This program is in addition to the Science Teaching Improvement Program [*Science*, **122**, 151 (22 July 1955)].)

The lack of appropriate reading material in small high schools deprives a large segment of the student population of the opportunity to learn what science is like and what scientists do. As a result, many young people with potential interest in careers in science fail to capitalize on their talents. Furthermore, many lack motivation to continue their education. It is also important that those not contemplating science careers be informed citizens in science as well as in other cultural areas.

It is the hope of the sponsors that the traveling science libraries will serve the following purposes: (i) develop greater interest on the part of high-school students in reading books on science and about scientists; (ii) make available to students a larger fund of factual information from the great scientific storehouse; (iii) develop a sounder basis for the choice of a career in science; (iv) afford science teachers an opportunity to extend their scientific reading; (v) stimulate an interest on the part of schools in purchasing similar collections of books for their libraries.

Selection of participating schools. Ten reasonably limited geographic areas, with varying cultural and educational characteristics, will be selected. In each area six senior high schools in the smaller communities will be chosen. The schools will be asked whether they wish to avail themselves of the traveling libraries; only those offering full cooperation will be given the privilege of participating.

Selection of books. The collection is to consist of 120 books covering the major fields, such as agriculture, anthropology, astronomy, botanical sciences, biology, chemistry, engineering, geology and geography, history and philosophy of science, mathematics, meteorology, medical sciences, physics, psychology, and zoological sciences. The selection will be based on the suggestions and recommendations of individuals, committees, and organizations representing the various scientific disciplines. The books to be included must contain authoritative scientific information written in a style that will interest high-school students. Textbooks or research monographs will not be included. In general the books will be chosen because they may be read and understood by persons with a limited background in science. A few, however, will be at a level to challenge the better students.

Plan of operation. The 120 books will be divided into 6 units of 20 each. Each unit will be fitted into an attractive case that can be used both for shipping and display. Each participating school will be permitted to retain each of the 6 units of 20 books for 4 class weeks. The first unit will arrive at each school about 1 Oct. 1955. All units will leave the schools approximately 1 May 1956.

Since the project is experimental and is supported by very limited funds, the libraries can be sent only to the selected schools. Voluntary applications for participation cannot be honored.

A brochure describing the collection and its use and containing a brief résumé of each book, will be sent to the school librarian and to the science teachers at

each school before the books arrive. A copy of the résumé will also be inserted in the front of each book.

The teachers and the school librarian will be asked to make known the availability of the books and to encourage students to read them. Class assignments may be used to stimulate interest in reading the books available during a given period, but the teachers in the participating schools will be requested not to make required reading of the volumes in the libraries. Nothing should be done to kill spontaneity. Each school will be expected to take all steps practicable to insure that as many students as possible have an opportunity to read the books during the time each unit is available.

Direction. Hilary J. Deason has been appointed director of the traveling science libraries program. Born in Utah and educated at the University of Michigan, he was granted his Ph.D. degree in 1936. After several years of work in fishery biology and limnology on the Great Lakes for the U.S. Bureau of Fisheries, he served as an administrator in the Fish and Wildlife Service in Washington. There he was responsible for the program of technical cooperation with foreign countries and training programs for foreign students. He was a member of the former Interdepartmental Committee on Scientific and Cultural Cooperation of the Department of State and has served as a delegate to various international conferences on conservation of biological resources and technical cooperation.

Recommendations from scientists, librarians, and teachers on books for the library list will be welcome and should be sent to Deason at the AAAS office. The selected books and a longer supplementary list will be given wide publicity.
—JOHN A. BEHNKE

Virology, a New Journal

The founding of a new scientific journal for the publication of basic research papers in the rapidly developing field of virology [*Science* **122**, 29 (1 July 1955)] is welcome news to scientists. This bimonthly journal, *Virology*, will publish papers dealing with biological, biochemical, and biophysical aspects of research on animal, plant, and bacterial viruses. It is hoped to bring together in one place some of the papers in these fields that previously have been scattered in at least 20 different journals. The publishers do not wish to monopolize the virus literature but rather they hope that, by publishing a representative sample of the research work in the several fields of virology, in a few years this journal may serve through its references as a key to the virus literature. A brief synopsis of the contents of the first issue, May 1955, indicates the scope of the journal.

F. O. Holmes describes the effects of thiouracil treatment on the course of infection of mosaic-hypersensitive tobacco plants with tobacco mosaic virus. This particular virus-host combination seems to be unique among plant virus diseases in that it is susceptible to cure by chemotherapeutic agents.

Quantitative studies of the multiplication of potato viruses X and Y in tobacco plants reported by Rochow and Ross indicate that the yield of virus X is greater in mixedly infected plants than in those infected with virus X alone. The actual excess of virus X varied with the stage of infection and with environmental influences. The yield of virus Y was not affected by the presence of virus X. The next paper by Rochow, Ross, and Siegel reports a study of electron-microscope particle counts and local lesion counts as methods of assay for potato virus X in doubly infected plants. The two methods are in quantitative agreement in demonstrating a greater yield of virus X in plants mixedly infected with X and Y viruses.

A kinetic study of Lanni and Lanni of the interaction between influenza virus and the inhibitory mucoprotein of egg white indicates that there is a progressive alteration in the properties of inhibitor molecules as a result of the action of virus enzyme rather than a sudden loss of inhibitory activity by a single act per inhibitor molecule. This results in altered inhibitor molecules with a reduced affinity for indicator virus.

The propagation of pantropic and neurotropic strains of Rift Valley fever virus in rat ascites hepatoma cells is reported by Takemori, Nakano, Hemmi, and Kitaoka. During cultivation in the hepatoma cells, there was a high rate of mutation of the neurotropic strain to a variant that was pathogenic for mice by the subcutaneous route, yet retained its neurotropic property and antigenic specificity.

A further study of the effects of proflavine treatment on phage-infected bacteria was reported by DeMars. Treatment of T2-infected *coli* bacteria with proflavine prevented development of mature phage particles but did not prevent the synthesis of specific phage constituents. Material capable of combining with phage-neutralizing antibodies, the phage tail antigen, is produced in proflavine-treated bacteria in the same yield as in untreated bacteria; but, instead of being liberated as part of the phage particle, it is in the form of elements much smaller than phage particles. Phage nucleic acid, phage head antigen, and phage tail antigen are all synthesized in normal amounts in proflavine-treated bacteria but are not assembled into infectious phage particles.

Colicine K has the same receptor site on the bacterial cell as does coliphage T6. In a comparative study of these two agents, Latarjet and Fredericq found that their bactericidal activities had the same sensitivity to inactivation by x-rays. This suggests that the tip of the phage tail responsible for phage adsorption and for its bactericidal properties may have the same size as colicine K as well as having the same receptor specificity.

Further studies correlating chemical substances with physiological properties in bacteriophage T2 were reported by Hershey. On osmotic shock the phage particle is disrupted to form a phage "ghost" containing most of the protein, soluble phage nucleic acid, and an antigenically distinct protein fraction that does not sediment with the ghosts and amounts to about 3 percent of the total phage protein. This "nonsedimentable" protein fraction is not a basic protein, but it is injected into the host cell along with the phage nucleic acid. Its function is at present unknown.

The kinetics of release of polio virus from individual infected monkey kidney cells in culture was reported by Lwoff, Dulbecco, Vogt, and Lwoff. With type 1, Brunhilde strain, there was a latent period of 5 to 7 hr, after which most of the virus was released during the succeeding hour. Characteristic changes in cellular morphology are correlated with virus release.

With this promising start, the new journal, *Virology*, is likely to become one of the most widely read journals in the biological sciences. It satisfies a real need in the field of scientific publications.—M. H. A.

Commercial Electric Power from Atomic Energy

General Electric Co., producer, and Niagara Mohawk Power Co., distributor, on 18 July at West Milton, N.Y., sent the first commercial electric power produced by a nuclear reactor into American homes and factories.

The source was a reactor built by the Knolls Atomic Power Laboratory, operated for the Atomic Energy Commission by General Electric Co. The reactor was built as the prototype for the one to be used in America's second atomic-powered submarine, the *Seawolf*. The reactor uses neutrons in the intermediate energy range. Heat from the reactor is transferred to a heat exchanger by liquid sodium. Steam generated in the heat exchanger is used to drive turbines connected to the submarine propeller shafts.

The *Seawolf*, built by General Dynamics Corp., was launched in Groton,

Conn., on 21 July. It is 330 ft long, as compared with the 300 ft of the first atomic-powered submarine, the *Nautilus*. The *Seawolf* is expected to have a submerged cruising speed in excess of 20 knots.

In the prototype reactor at West Milton, the steam drives a turbine generator with a maximum rating of 12,500 kw. With more power being produced than is needed for studies of the *Seawolf* operation, General Electric contracted with the Niagara Mohawk Co. for the sale and distribution of excess amounts. The amount to be sold will vary, depending on the excess available, but will not exceed 10,000 w. Ten thousand watts is normal consumption for a city of 20,000 to 30,000 people.

The arrangement with the Niagara Mohawk Co. is temporary. Under existing law, public and cooperative power plants must be given first opportunity to purchase power generated in government projects. The Knolls Atomic Power Laboratory is an Atomic Energy Commission installation. Three such companies operate near West Milton and are eligible to receive the power.

Power is being sold at 3 mills/kw. The money goes to the Federal Government. Cost of production was not released, but it is greater than the 3-mill rate at which it is being sold. The reactor, however, was not built to be competitive with other sources of commercial power.

The throwing of the switch that for the first time made electricity from an atomic source available through the usual commercial channels was preceded by a program in which Francis K. McCune, vice president of General Electric and general manager of the company's Atomic Products Division, Senator Clinton P. Anderson, chairman of the Joint Congressional Committee on Atomic Energy, Douglas McKay, Secretary of the Interior, Ralph J. Cordiner, president of G.E., and Lewis L. Strauss, chairman of AEC, all spoke.

In concluding a series of brief talks that had given emphasis to the day's event as marking the beginning of new advances in the atomic age, Strauss commented:

"Before me stands a large two-way switch. If I throw its blade in one direction it will turn the propeller shaft of a military weapon.

"But when I throw it in the other direction, as I am about to do, it will send atomic electric power surging through transmission lines to towns and villages, farms and factories—power not to burst bombs or propel submarines, but to make life easier, healthier, and more abundant.

"This switch is a symbol of the great dilemma of our times.

"I throw it now to the side of the peaceful atom. . . ."

NIH Directorship Changes

WILLIAM H. SEBRELL, JR., director of the National Institutes of Health and Assistant Surgeon General, U.S. Public Health Service, will retire 1 Aug. He will be succeeded as director of the institutes by James A. Shannon, currently associate director. Sebrell has accepted a new position with the American Cancer Society.

Commenting on Sebrell's retirement, Surgeon General Leonard A. Scheele said: "His directorship has been invaluable in bridging a complex period of transition, not only in our own expanding research program but in medical research the world over. Doctor Sebrell, drawing upon a distinguished background of active research and administration, has been one of the Nation's leaders in the new research attack on disease, particularly the chronic diseases, such as heart disease, cancer, and mental illness."

Sebrell was born in Portsmouth, Va., in 1901. He received his medical degree from the University of Virignia in 1925 and entered the U.S. Public Health Service. In 1928 he joined the staff of the laboratory that was later to become the National Institutes of Health.

He earned a world-wide reputation as a medical scientist, particularly through his studies on the B vitamins. He was a member of the Public Health Service team that established in the 1920's the dietary origin, prevention, and treatment of pellagra, then one of America's most serious deficiency diseases. In the course of his work, Sebrell discovered the cause and cure of another vitamin-deficiency disease, ariboflavinosis. He has also received scientific acclaim for important findings in the dietary cause and treatment of liver disease, the effect of pantothenic acid deficiency on the adrenal glands, nutritional effects of the sulfonamides, and the cause and treatment of blood abnormalities. In 1950 he was appointed director of the National Institutes of Health.

Sebrell has taken a leading part in nutrition studies throughout the world. For his work in this field he holds the Legion of Merit. He has been honored for his achievements in the field of nutrition research with the Mead Johnson award of the American Institute of Nutrition, the Research medal of the Southern Medical Association, and the Goldberger award of the Council on Nutrition of the American Medical Association. He has written more than 100 scientific papers on nutrition and public health. In 1954 he was elected president of the National Vitamin Foundation and vice president of the American Board of Nutrition.

In his new position as research consultant at the American Cancer Society, effective 1 Aug., Sebrell will direct the society's institutional research grant program, which involves about half of the society's expenditure of $6 million for research this year.

James A. Shannon, the new director of the National Institutes of Health, has been associate director since November 1952. His principal responsibilities have included development of the NIH direct research program. He is also chairman of the Public Health Service's Technical Committee on Poliomyelitis Vaccine. Prior to 1952 he was associate director in charge of research at the National Heart Institute.

The heart institute is one of seven research centers comprising the National Institutes of Health. Other separate institutes cover cancer, neurological diseases and blindness, arthritis and metabolic diseases, mental health, dental research, and microbiology.

The NIH is the site of the Clinical Center, a new 500-bed research facility opened in 1953. Other major programs of the NIH include substantial financial support through research grants to investigators in non-Federal institutions and support of research fellowships and clinical traineeships.

Genetics of Extinct Species

That we need not always be ignorant of the genetics of extinct species has been demonstrated by a remarkable comparative study of the molar teeth of the present-day European brown bear (*Ursus arctos*), the extinct late Pleistocene cave bear (*U. spelaeus*), and other still older, early Pleistocene bears of Europe, including *U. etruscus*, the common ancestor of these bears. Björn Kurtén, of the Geological Institute of Helsingfors University, Finland [*Evolution* **9**, 107 (1955)], finds that these teeth show allometric growth, according to the well-known equation $y = bx^k$. That is, they exhibit a constant differential growth ratio (k) between the height of the cusps, or paracones, on the tooth (y) and the length of the crown (x).

The ratio is different in the cave-bear samples from the ratio in the majority of recent and fossil brown bears, but some populations of the brown bear reveal the typical cave-bear kind of tooth growth. Both kinds of tooth growth are also present in the ancestral species *U. etruscus*.

There is some evidence that the two types of tooth growth differ by a single Mendelian factor, for the frequencies of the two types and an intermediate between them fit the expectations derived from the Hardy-Weinberg principle. Hence, it is possible to say that the mu-

tation that produced the characteristic type of tooth growth of the cave bear and is still present in some modern brown bears traces back through roughly a million years, where it may still be studied in the biometric variations of the fossil *U. etruscus.*

The fairly strong allometric growth in both types leads to a diminished fitness of the shape of the tooth crown as the tooth enlarges excessively in size, just as it did in the cave bear toward the time of its extinction. Very likely the existence of the two types of allometric growth of the teeth and the intermediate between them made it possible for bears of different sizes to possess teeth of the optimal shape.—B. G.

News Briefs

■ The State Department on 8 July issued a passport to Martin D. Kamen, former atom bomb project chemist and now an associate professor at Washington University, St. Louis. For the past 8 years, Kamen has been seeking a travel permit in order to accept speaking engagements abroad [*Science* **121,** 758 (27 May 1955)]. On 14 July the State Department formally withdrew its charges that Kamen is a supporter of Communism, and Kamen's suit to force issuance of a passport was dropped.

■ The areas in six southwestern states that are regulated because of the pink bollworm of cotton will be merged into a single continuous regulated area, instead of being divided as now into heavily and lightly infested areas, the U.S. Department of Agriculture has decreed. This change became effective 12 July. At the same time 20 Arkansas counties were added to the regulated area. Merging of the lightly and heavily infested pink bollworm areas became necessary because heavy infestations have been found sporadically throughout the entire regulated area. It was therefore no longer practicable to operate the quarantine on a two-area basis.

■ The Mediterranean fruit fly has been found in almost every part of Costa Rica, it has been announced by the Agriculture Ministry and United States technical aid authorities. The pest, which attacks many forms of ripe fruit, was first detected a few weeks ago by Harold Mowry, acting chief of the technical aid program. Subsequent spot checks have revealed many other infestations. Identification was confirmed by laboratory tests in Washington.

The infestations of Mediterranean fruit fly have not been serious in this hemisphere, except in isolated spots in southern Brazil, since the 1929 infestation in Florida, which did heavy damage to the citrus industry.

The Costa Rican government plans an eradication campaign. In an effort to prevent spread of the infestation, the government of Nicaragua has embargoed imports of Costa Rican fruits, plants, and seeds. Other control measures may be instituted in Costa Rica and elsewhere.

■ The National Society of Professional Engineers has urged a House committee to approve pending legislation that will give more liberal tax benefits to self-employed persons who wish to establish an individual retirement plan.

Paul Robbins, executive director of NSPE, in recent testimony before the House Committee on Ways and Means, stated that present tax rates "do not leave the average self-employed professional person enough to cover living costs and a residue for the relatively high payments which are required for an acceptable private pension plan." Pointing out that salaried employees can receive "substantial tax benefits under existing favorable tax law provisions," Robbins added that the professional man alone "stands in a position where high surtaxes prevent him from leveling his earnings to provide a stable income and retirement benefits."

Robbins testified that "in all fairness the laws should be written to permit those who earn their income by a personal practice of a profession to project some portion of their earnings into the future for tax purposes" and emphasized that the nation can ill afford to discourage young people "from embarking on professional careers by presenting them with a prospect of rewards not commensurate with the risks they are asked to run."

■ Proposed agreements for the exchange of atomic information for mutual defense purposes have been approved by President Eisenhower, signed by representatives of Canada, the United States, and the United Kingdom, and submitted to the Joint Committee on Atomic Energy of the U.S. Congress. According to the terms of the U.S. Atomic Energy Act of 1954, the proposed agreements are to lie before the Joint Committee for a period of 30 days before becoming effective.

Scientists in the News

AUGUST C. HELMHOLZ has been appointed chairman of the department of physics at the University of California. He succeeds RAYMOND T. BIRGE, who retired 1 July. Helmholz has been a member of the Berkeley staff since 1940. ERWIN L. HAHN, now with the I.B.M. Corp. at the Watson Laboratory, Columbia University, will join the Berkeley staff in September. Other departmental changes at Berkeley include the promotion to full professor of WILLIAM B. FRETTER, WILLIAM A. NIERENBERG, and CORNELIUS A. TOBIAS.

On 17 June at the commencement in Berkeley, Calif., the University of California awarded to RAYMOND THAYER BIRGE an LL.D. degree, thereby recognizing his long years of distinguished service as a scientist, teacher, and administrator. Birge retired as chairman of the department of physics on 1 July, 1955, having served in this position since 1933.

After completing his academic training through the Ph.D. degree at the University of Wisconsin, Birge served for 5 years on the physics staff of Syracuse University. In 1918 he came to the University of California as an instructor and rose rapidly to full professorship in 1926. Although he reached the retirement age in 1954, he was reappointed for the year 1954–55. During his period as chairman, the department grew in both numbers and eminence, and his guiding hand was largely instrumental in this rise.

Birge's research interests were originally in spectroscopy; he entered the field at the time that Bohr's quantum theory of the hydrogen atom was first published, and his researches did much to interpret the spectra of molecules in terms of this theory and developments from it. The use of intensities in the rotational structure of band spectra to measure the temperature of emitting molecules was introduced by him in 1921. He was one of the first to employ data on the vibrational and rotational states of diatomic molecules to determine the force law constants and to examine critically their interrelations. Soon after it was realized that the presence of isotopes in diatomic molecules was manifested in their spectra, he was largely instrumental in the discovery of the rarer isotopes of hydrogen, carbon and oxygen. The celebrated Birge-Sponer method of extrapolating vibrational energy levels to evaluate heats of dissociation was discovered in 1926 and has proved to be a powerful method of estimating these quantities for the more stable diatomic gases.

Through his interest in spectroscopy, Birge was led to examine the relationships between the constants of atomic physics—for example, in the Rydberg constant and the fine-stucture constant. In pursuing this line, he became, for many years, the leading authority on the best values of the whole array of general constants. His thorough investigations pointed up many discrepancies in the values of the physical constants then known and stimulated much important work in the resolution of these difficulties. In the course of this work, he developed an interest in the propagation of errors

and in the statistical treatment of data and has made important contributions to both of these fields. The present satisfactory state of our knowledge of the physical constants is, in large part, the result of Birge's pioneering work.

Birge was a member of the Division of Physical Sciences of the National Research Council from 1930 to 1937, and was chairman of the Committee on Physical Constants from 1930 to 1937. He served as Pacific Coast secretary of the American Physical Society from 1941 to 1946. He was elected to the National Academy of Sciences in 1932 and acted as chairman of the Physics Section from 1942 to 1945. He has been a member of the American Philosophical Society since 1943. He was elected vice president of the American Physical Society for the year 1954 and is now serving as president.

IRVING H. LEOPOLD has been appointed chairman of the department of ophthalmology in the University of Pennsylvania's Graduate School of Medicine. He succeeds EDMUND B. SPAETH, who is relinquishing the chairmanship but who will continue to teach and practice.

GILBERT F. WHITE has resigned as president of Haverford College, effective 1 Jan., to become professor of geography at the University of Chicago. A geographer specializing in land and water conservation, White continued activity in this field while he was president of Haverford. He is the U.S. member of UNESCO's Advisory Committee on Arid Zone Research and was chairman of the International Conference on Arid Lands sponsored by the AAAS in April.

Two recent appointments at Harvard University are those of SYDNEY GOLDSTEIN as Gordon McKay professor of applied mathematics in the division of engineering and applied physics, and WALTER M. BOAS as visiting lecturer on metallurgy for the 1955–56 spring term.

Prior to coming to Harvard in 1952 as Gordon McKay visiting lecturer on applied science, Goldstein was vice president of the College of Technology in Haifa, Israel. Boas is currently serving as chief of the division of tribophysics of the Commonwealth Scientific and Industrial Research Organization in Australia.

GERALD S. TOMPKINS, who has been a vice president in charge of production, has been elected president of American Viscose Corp.

WILLIAM C. FOSTER, former Deputy Secretary of Defense and president of the Manufacturing Chemists' Association, will become an executive vice president of Olin Mathieson Chemical Corp. on 1 Aug.

JAMES B. SUMNER, the first scientist to crystallize an enzyme, and the winner in 1946 of a Nobel prize in chemistry, retired on 1 July from Cornell University, where he had taught since 1914. He joined the staff of the Cornell Medical School as assistant professor of biochemistry and for 26 years served as professor of biochemistry, first in the College of Arts and Sciences and later in the College of Agriculture. In 1947 he was appointed director of Cornell's laboratory of enzyme chemistry.

Sumner began his research on the isolation of an enzyme, urease, in 1917. While he was a student at Harvard Graduate School, where he received his Ph.D. in 1914, one of his professors had stated that such an accomplishment was impossible without a revolutionary change in methods. Sumner considered this a challenge; his persistence was rewarded in 1926 when he first crystallized urease. This discovery started an immense burst of activity in the biological sciences. About 30 enzymes have been crystallized since then, and his recent research has dealt with 12 of them.

Sumner has published more than 100 research papers in his field. With G. Fred Somers he wrote *The Chemistry and Methods of Enzymes,* published in 1943 and now in its 3d edition. In 1950 and 1952 he edited, with K. Myrbäck, two volumes, *The Enzymes,* containing articles written by 78 scientists.

Our society today, Sumner feels, places too little emphasis on helping the individual scientist and too much on backing large groups of researchers striving for immediate practical results. Speaking as a teacher, he said that too many students have this same philosophy, preferring to learn recently discovered facts for immediate application only, and that if this continues, man's quest for knowledge will stagnate.

Sumner was born in Canton, Mass., in 1887. At 17, he lost one arm in a hunting accident. He was told that, as a result, he would be unable to become a chemist, but he went on to achieve his ambition despite the handicap. His honors include membership in the National Academy of Sciences.

ERNEST F. BARKER has turned over the chairmanship of the University of Michigan physics department to DAVID M. DENNISON, after serving 14 years in that capacity and 33 years as a faculty member.

Barker joined in the quest for knowledge of atomic and molecular structure through the study of the infrared spectra, his field of specialization. His early work on such molecules as those of carbon dioxide and ammonia helped to open a whole new field of research. Barker expects to resume his scientific research on diffraction gratings designed for infrared studies.

Dennison has been a member of the physics department since 1927 and is internationally known for his interpretation of experimental data on the structure of molecules.

JOHN O. WAGNER, former chief engineer of the Materials Section for Rockets and Guided Missile Components, Navy Bureau of Ordnance, has joined the Defense Products Division of the M. W. Kellogg Co. as its Washington representative.

FRANKLIN S. COOPER, research physicist, has been elected president and director of research of Haskins Laboratories of New York. He succeeds CARYL P. HASKINS, who has resigned to accept the presidency of the Carnegie Institution of Washington next January.

The Army announced on 6 July that HERMANN OBERTH, German physicist rocket pioneer, had recently come from West Germany to work on the development of guided missiles at Redstone Arsenal in Huntsville, Ala. It is reported that Oberth rejected invitations to work in East Germany. According to Army disclosures, several former German scientists work at Redstone Arsenal under WERNHER VON BRAUN, developer of the German V-2 rocket of World War II.

F. DOUGLAS LAWRASON, assistant dean of the University of North Carolina School of Medicine and assistant professor of medicine, has been appointed provost for medical affairs and acting dean of the Medical School at the University of Arkansas.

ALFRED D. STARBIRD of the office of the Chief of Engineers, U.S. Army, became director of the U.S. Atomic Energy Commission's division of military application on 1 July.

ROLLIN H. BAKER, associate professor in zoology and assistant curator of mammals in the Museum of Natural History at the University of Kansas, has been appointed professor of conservation and director of the university museum at Michigan State University. He will assume his new duties in September.

DAVID A. RYTAND, executive head of the department of medicine at Stanford Medical School, will tour European medical centers this summer under a $2350 grant from the Rockefeller Foundation. He will visit famous Old World institutes in London, Stockholm, Copenhagen, and Paris to observe their teaching and research in medicine. He will return to San Francisco in September.

PITIRIM A. SOROKIN, well-known Harvard University sociologist, will retire from teaching on 31 Aug. He will continue to direct the university's center for research in creative altruism.

The more than 30 books that he has written include *Contemporary Sociological Theories*, first published in 1928. In the 4-volume *Social and Cultural Dynamics* (1937–40), Sorokin presented his philosophy of history. Periods of "sensate" culture, based on a materialistic outlook and developing strong natural sciences, alternate with periods of "ideational" culture, based on faith, mysticism, and authority, as in medieval European society. He believes that our own Western culture is sensate and that its breakdown is at hand.

Sorokin was born in Russia 66 years ago. Active in Russian politics before the revolution, he was banished by the Bolsheviks in 1923. Coming to America, he taught at the University of Michigan from 1924 to 1930. In the latter year he became a United States citizen. He joined the Harvard faculty in 1931. In 1937 he was president of the International Congress of Sociology.

ARNO C. FIELDNER, 74 years old, government research scientist and an expert on fuels, has retired.

F. F. NORD, Fordham University, New York, has received an honorary degree of doctor of agricultural sciences from the University of Pisa, Italy, in recognition of his work on lignin and the mechanism of enzyme action.

SUNIL CHANDRA DATTA, pharmacognosist, Indian Food and Drug Administration, after spending more than a year at the Philadelphia College of Pharmacy and Science, has returned to Calcutta.

CHARLES H. WEAVER, who has directed the atomic power division of Westinghouse Electric Corp. since it was organized in 1948, has been elected a vice president, with responsibility for all Westinghouse atomic power activities. These will include the design and development of two additional atomic submarine power plants, the nuclear power plant for a large naval vessel, and the nuclear power plant for the nation's first full-scale atomic power plant for the generation of electricity.

GEORGE H. BOYD has relinquished his duties as head of the department of zoology at the University of Georgia in order to devote his full time to his work as dean of the graduate school and director of research. R. BARCLAY MCGHEE has replaced Boyd as head of the department of zoology.

WALTER C. RUECKEL, vice president of the Henry J. Kaiser Co., Oakland, Calif., has been elected vice president and general manager of the engineering and construction division of Koppers Co., New York.

EVERETT P. PARTRIDGE, director of Hall Laboratories, Pittsburgh, Pa., has been presented the 1955 Max Hecht award of the American Society for Testing Materials in recognition of his 30 years of contributions to the technology of industrial water.

ROBERT PERLOFF, former supervisory research psychologist in the Department of the Army and chief of the statistical research and consultation unit of the Adjutant General's Office, has joined the staff of Science Research Associates, Chicago, as director of test research.

DAVID LYALL has been promoted from associate professor to professor of clinical surgery at the Post-Graduate Medical School of the New York University–Bellevue Medical Center. He has also been appointed director of the center's University Hospital Tumor Service and the Fourth Surgical Division of Bellevue Hospital, succeeding HERBERT WILLY MEYER, who resigned 1 July. PAUL S. SEAGER has been promoted from associate professor to professor of clinical otorhinolaryngology.

GILES F. FILLEY will join the department of medicine at the University of Colorado Medical Center on 1 Sept. He will also serve as clinical physiologist at the Colorado Foundation for Research in Tuberculosis. Filley was formerly director of the department of physiology, Trudeau-Saranac Institute, Trudeau, N.Y.

HENRY W. FITZPATRICK has been appointed director of defense laboratories at the Massachusetts Institute of Technology, succeeding HORACE S. FORD. The duties of director include administrative responsibility for Lincoln Laboratory in Lexington, the Instrumentation Laboratory in Cambridge, and the Operations Evaluation Group in Washington.

A. JUDSON WELLS, an assistant research director of the Du Pont Co.'s film department and director of the Yerkes Research Laboratory in Buffalo, N.Y., will move to Wilmington, Del., 1 Sept. to devote full time to his work as assistant research director. CLEMENT W. THEOBALD, who has been research manager at the laboratory, will succeed him as director there. In the meantime, Theobald will act as deputy director of the laboratory. FREDERICK W. GANDER, a research supervisor, has been named research manager.

Necrology

ADELBERT AMES, JR., Hanover, N.H., 74, research professor in the department of physiological optics at Dartmouth, former director of Dartmouth Eye Institute, discoverer of cure for aniseikonia, 3 July.

H. SHERIDAN BAKETEL, Philadelphia, 83, former professor of preventive medicine at Long Island College of Medicine, editor of *Medical Economics*, former president of the American Pharmaceutical Manufacturing Association, 7 July.

EDWARD S. BROWN, Phliadelphia, 49, an osteopathic surgeon and chief of the department of chest surgery at Metropolitan Hospital, 12 July.

WALTER L. CHENEY, Washington, D.C., 65, professor of physics at George Washington University, 6 July.

REINA A. HUTNER, Hastings-on-Hudson, N.Y., 44, research scientist, Haskins Laboratories, former member of Office of Scientific Research and Development, 4 July.

WENDELL M. LATIMER, Oakland, Calif., 62, former dean of the college of chemistry, associate director of the radiation laboratory, University of California, 1954 chairman of AAAS Section C, 6 July.

PAUL DE LESSEPS, San Sebastian, Spain, 75, industrial engineer and only surviving son of builder of the Suez Canal, 11 July.

GUSTAVE MAGNEL, Brussels, Belgium, 65, professor of civil engineering at the University of Ghent, inventor of Belgian system of prestressed concrete construction, 5 July.

ETIENNE OEHMICHEN, Paris, 72, researcher in helicopter aviation, naturalist, author, 10 July.

OSCAR ORIAS, Buenos Aires, 49, director of Instituto de Investigación Médica-Mercedes y Martin Ferreyra, physiologist, author, 4 June.

ERNEST R. SASSCER, Washington, D.C., 72, retired head of the U.S. Department of Agriculture, division of foreign plant quarantines, former president of the AAAS and of the Entomological Society of America, 7 July.

RUFUS E. ZIMMERMAN, New York, 68, president of American Standards Association, former chairman of research policy committee, 21 June.

In the Laboratories

■ A tiny new electronic device made of extremely pure silicon shows promise of reducing costs on a large scale in many industries using electric power, Bell Telephone Laboratories has announced.

The simple device—a silicon power rectifier—converts alternating current into direct current, an essential step in the operation of telephone systems. In-

dustries and homes also depend on rectifiers to convert alternating to direct current. It is not economically feasible to generate and transmit direct current.

Despite a trend in recent years toward smaller and more efficient components, power rectifiers have remained large, limited in efficiency, and in need of bulky cooling equipment to prevent overheating.

It is believed that the new power rectifier will far surpass any yet made of silicon or other material. Expectations are that it may have an almost unlimited life-span, and will be capable of operating continuously at temperatures up to 400°F. These advantages are expected to open up many new uses in telecommunication, heavy industry, and in military applications.

The new silicon rectifiers provide 5000 times more current than conventional rectifiers of the same size, thus permitting miniature operating units. Even so, the newest techniques may be applied to large units and thereby provide entirely new power possibilities for industry. On a machine the size of a locomotive, for example, significant amounts of space may be saved by the new rectifiers.

■ The Shell Chemical Corp. has announced plans to build a new urea plant at Ventura, Calif. Construction will start shortly, and the plant will be in operation by Sept. 1956, with a capacity of more than 100 tons a day.

■ Corning Glass Works has announced the development of a fast, economical method for the precision casting of metals through the use of glass molds. The process, called Glascast, is designed especially for work with high-temperature alloys. It eliminates the precoat step, and has given excellent results with test production of castings.

Fabrication of the molds requires a minimum of equipment and material, the time of preparation is reduced, and the technique is suitable for any of conventional casting methods used with aluminum, brass, carbon steels, cobalt-base alloys, and chromium-base alloys.

■ A new type of "moving sidewalk" that can go around corners and carry passengers in two directions has been demonstrated at the plant of Hewitt-Robins, Inc., Passaic, N.J., manufacturer of rubber and conveyer machinery products.

Passengers stand on a rubber carpet fastened to a train of pallets, mounted on rubber-tired wheels that run on a steel track. When going around a curve, the rubber carpet stretches on the outside curve and contracts on the inside. The conveyer is driven by electric motors that transmit power to the pallets by means of a "caterpillar" type of chain, which engages steel "dogs" on the underside of each pallet. The carpet itself does not help to pull the load but functions as a smooth, antiskid surface for the passengers to stand on. The conveyer can carry passengers in two directions because it can turn around and travel in a continuous circuit. It is designed to run at a speed of 1 2/3 mi/hr, average walking speed, but can be adjusted to run faster or more slowly.

Three of the new conveyors will be installed in the new air terminal to be built at Dallas Love Field, Dallas Tex., They will carry passengers and their baggage from the ticket office to planes and bring incoming passengers from the planes into the terminal. The total length will be 1406 ft. The Dallas installation is scheduled for completion in 1957. It will cost $234,703.

Miscellaneous

■ The International Commission on Zoological Nomenclature will start to vote 7 Jan. 1956 on the following cases, involving the possible use of its plenary powers, for the purposes specified against each entry. Full particulars of these cases were published on 7 July in parts 7 and 8 of volume 11 of the *Bulletin of Zoological Nomenclature*.

1) *Gnathophyllum* Latreille, 1814 (Cl. Crustacea, Order Decapoda), validation of emendation from *Gnatophyllum;* Hippolytidae Bate, 1888 and Eugonatonotidae Chace, 1937, validation of.

2) Mayaitidae Spath (L.F.), 1928 (Cl. Cephalopoda, Order Ammonoidea), validation of.

3) *Lernaeocera* Blainville, 1822 (Cl. Crustacea, Order Copepoda), validation of emendation from *Lernaeocera*, and designation of a type species for.

4) Proposed grant to the ICZN for authority to prescribe for generic names a gender different from that grammatically appropriate when such action is needed in the interests of nomenclatorial stability.

5) Determination of a gender for (i) generic names in the Class Aves that have the termination *-rhynchus*; (ii) generic names in the Order Decapoda (Cl. Crustacea) that have the terminations *-opsis* and *-gnathus;* and (iii) for the following names: *Gigantorhynchus* Hamann, 1892 (Cl. Acanthocephala), *Desmognathus* Baird, 1830 (Cl. Amphibia), *Nephrops* Leach, [1814] (Cl. Crustacea, Order Decapoda), and *Syngnathus* Linnaeus, 1758 (Cl. Pisces).

6) *Varuna* Milne Edwards, 1830 (Cl. Crustacea, Order Decapoda), validation of currently accepted gender for.

Proposals are also made for the adoption of the following "Declarations": (i) Article 21, clarification of the authorship to be attributed in certain circumstances to zoological names and to actions affecting the status of such names; and (ii) Article 25, clarification of the status of names published only in the indexes of books. Comments should be sent as soon as possible to Francis Hemming, Secretary to the Commission, 28 Park Village East, Regent's Park, London, N.W.1.

■ Descriptions of 20 patents owned by the U.S. Government and held by the Atomic Energy Commission have been released by the commission. The AEC will grant nonexclusive, royalty-free licenses on these patents, as part of its program to make nonsecret technologic information available for use by industry. Commission-held patents and patent applications released for licensing now total 767. Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U.S. Atomic Energy Commission, Washington 25, D.C., identifying the subject matter by patent number and title. Copies of these patents may be obtained from the U.S. Patent Office.

■ Preparation of an up-to-date aeronautical dictionary has been undertaken by the National Advisory Committee for Aeronautics. The basic aim of the new dictionary, which will be compiled under the direction of Frank D. Adams, will be to reflect the best current usage of those terms peculiar to aeronautics, as well as those terms that have special significance when they are used in aeronautical literature. Preferred usage of terms will be indicated, but well-established usages that may be considered less desirable will also be included. It is hoped that publication can take place in 1957.

■ A comprehensive appraisal of the status of educational television in the United States will be undertaken during the academic year 1955–56 by the Educational Television and Radio Center, Ann Arbor, Mich. The detailed appraisal of ETV is being made possible by a grant from the Fund for Adult Education.

Richard B. Hull, radio-television director of Iowa State College, has been appointed director of the project. Hull has been granted a year's leave of abscence from his Iowa State position to assume the new responsibilities. During the course of the year, Hull will gather firsthand information on the operations of all ETV stations now on the air and those scheduled to begin broadcasting in the near future. He also will meet with leading educational and civic authorities in an effort to appraise the successes, failures, and potentialities of the medium in education.

Reports and Letters

Radiation Sensitivity of Dormant and Germinating Barley Seeds

Recent investigations (*1*) have indicated that when seeds are irradiated with x-rays, some are severely damaged but others are only very slightly damaged. However, when seeds are irradiated with fast or thermal neutrons, all are damaged to a similar extent. This phenomenon indicates a qualitative difference between x-ray and neutron irradiation. A possible explanation of this phenomenon is that the seeds are actually not all alike but differ in some characteristics that are very important for their response to x-rays but unimportant for their response to neutrons. Our experiments were undertaken to test this hypothesis and to elucidate the factors responsible for radiosensitivity of seeds. (*2*)

One obvious factor that might be considered is the water content. Accordingly, barley seeds were presoaked on wet blotters for times up to 24 hr at 22°C prior to irradiation. The water content of the seeds was determined at the time of irradiation. Neutron exposures were performed in the thermal column of the Brookhaven reactor (flux approximately $9 \times 10^8 n_{th}/cm^2$ sec; cadmium ratio 5000:1; gamma contamination approximately 100 r/hr). X-ray exposures were made at 250 kv, 30 ma, with 1-mm Al filtration. The intensity was about 800 r/min. After irradiation, the seeds were planted in flats, and the height of the seedlings was measured as a function of time. In general, the height at 14 days was taken as a measure of the extent of injury.

Results of a representative series are shown in Fig. 1. The seeds were exposed to either 4000 r of x-rays or 1.3×10^{13} n/cm^2. For seeds exposed to x-rays, the sensitivity is extremely dependent upon water content, but the sensitivity of seeds exposed to neutrons is comparatively independent of water content over a wide range. Indeed, after 6 hr of germination, seeds are less sensitive to neutron irradiation than dormant unsoaked seeds are.

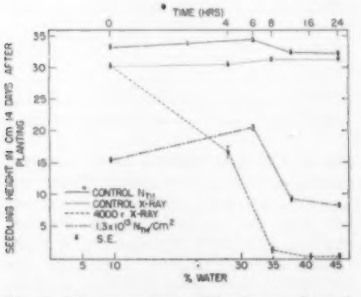


Fig. 1. Water content of barley seeds and time of germination prior to irradiation.

The interpretation of these results is not at once clear, but one obvious possibility presents itself. Soaking the seeds changed their physiological state, as was shown by the increased metabolic activity and germination. Thus, it seems reasonable to assume that these effects are caused primarily by changes in the physiological state of the seeds. This influence of physiological state was known from earlier x-ray experiments (*3*). However, the influence on neutron sensitivity was not clear, and another series of experiments was undertaken, namely, soaking seeds at 0°C in order to increase their water content but to limit corresponding changes in physiological state. To date, the results are only preliminary, because facilities for irradiation at different temperatures in the thermal column are not yet complete. However, they clearly show that increasing the water content at low temperature has less effect on x-ray sensitivity than it has at high temperature. Furthermore, seeds exposed to thermal neutrons after low-temperature soaking do not respond in ways markedly different from those soaked at room temperature. Thus, it seems that water content per se, if it is important in determining radiosensitivity, plays a role that is not immediately evident.

The biological action of x-rays appears to be more dependent on the physiological condition of the irradiated object than that of neutrons is; therefore, it is reasonable to explain the lower uniformity of damage to individual seeds as related to slight variations in metabolic stage.

The reason for the differences between the actions of x-rays and thermal neutrons is not readily apparent. Certain dissimilarities in their actions can be explained by their different chances to produce biological events as well as by their different biological efficiencies. Protons and alpha particles, both of which are densely ionizing, are the principal means of energy dissipation characteristic for the capture reactions of thermal neutrons in living tissue (*4*). Dense ionization is highly efficient when more spatially concentrated energy is needed, but it is inefficiently utilized when little energy is necessary. On the other hand, the ionization along the electron tracks produced by x-rays is sparse and unevenly distributed, although for a given amount of energy absorbed there is a more uniform distribution of ionization throughout the cell. Sparse ionization has a high efficiency only for events requiring small amounts of energy (*5*). A decrease in the threshold energy required for the events should increase the relative efficiency of x-rays; the reverse should be true for neutrons. From this knowledge, it is logical to interpret the increased relative efficiency of x-rays on presoaked seeds as the result of a reduction in the amount of energy necessary to produce the biological events. This relationship of radiation damage to the structural stability of cell components has also been presented recently in a similar way by Caldecott (*6*).

In summary, striking differences in the relative sensitivity of seeds to x-rays and thermal neutrons were observed. These differences were considered to be associated with changes in physiological state which differentially influence the relative efficiency of the two radiations.

CALVIN F. KONZAK
Biology Department, Brookhaven National Laboratory, Upton, New York

References and Notes

1. J. MacKey, *Hereditas* **37**, 421 (1951); R. S. Caldecott *et al.*, *Genetics* **39**, 240 (1954).
2. This research was carried out at Brookhaven National Laboratory under the auspices of the U.S. Atomic Energy Commission.
3. E. Wertz, *Strahlentherapie* **67**, 307, 536, 700 (1940); **68**, 136, 287 (1940); K. Sax, *Proc. Natl. Acad. Sci. (U.S.)* **25**, 225 (1939).
4. J. W. Schmidt and E. F. Frolik, *Univ. of Nebraska Research Bull.* 167 (1951).
5. L. H. Gray, *Radiation Research* **1**, 19 (1954).
6. R. S. Caldecott, *Radiation Research*, in press.

14 March 1955

Methylamine Complexes of Yttrium Chloride

In a recent study it was found that methylamine forms addition complexes with the anhydrous rare-earth chlorides of lanthanum, cerium (III), praseodymium, neodymium, samarium, and gadolinium (*1*). The composition of these complexes can be designated as $RE(CH_3NH_2)_nCl_3$, where n has values of 1 to 5. Since yttrium salts are chemically similar to the corresponding rare-earth compounds, the complexes with methylamine should be analogous; to a certain extent, this was found to be the case.

The reaction between methylamine and yttrium chloride was studied by the method of isobaric thermal decomposition curves. This method consisted of the formation of the higher methylamine complex at 0°C, after which the complex was subjected to thermal decomposition at a constant pressure. The apparatus used has been previously described (*2*). The anhydrous yttrium chloride was prepared by heating the hexahydrate in a hydrogen chloride atmosphere with the following temperature stops: 4 hr at 90°C, 1 hr at 180°C, and 2 hr at 400°C (*3*). The resulting product was analyzed and found to be free of water. The preparation and purification of the methylamine has been described by Kenner and Felsing (*4*).

The thermal decomposition curve is shown in Fig. 1. According to the phase rule, a reversible phase that is stable over a specific temperature range can be considered a chemical compound. The curve was reproducible and reversible within an experimental error of ±0.5 percent. Four compounds can be identified from the curve: $Y(CH_3NH_2)_4Cl_3$, $Y(CH_3NH_2)_3Cl_3$, $Y(CH_2NH_2)_2Cl_3$, and $Y(CH_3NH_2)Cl_3$. The decomposition temperatures are given in Table 1.

It is interesting to note that a complex with five methylamine molecules was not found, as was the case with the rare-earth complexes. Even at 0°C, this complex could not be detected. It is obvious that the yttrium chloride complexes are less stable. According to ionic radii considerations, the smaller ion should form the more stable complex; therefore, the yttrium ion (1.06 A), being smaller than the rare-earth ions that were studied (122 to 1.11 A), should be more stable. Apparently other factors that make the influence of the smaller ion size of lesser importance must be present.

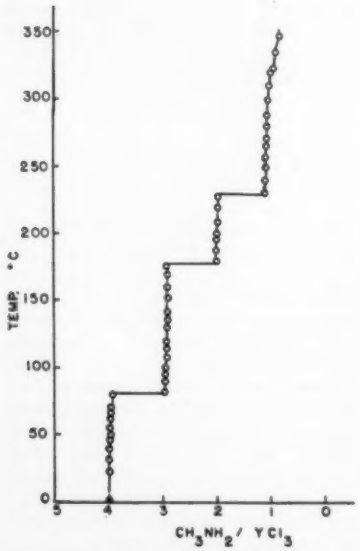


Fig. 1. The system of methylamine with yttrium chloride; pressure, 700 mm.

Table 1. Decomposition temperatures of the methylamine complexes of yttrium chloride

Transition	Temperature (°C)
$Y(CH_3NH_2)_4Cl_3 \rightarrow Y(CH_3NH_2)_3Cl_3 + CH_3NH_2$	82
$Y(CH_3NH_2)_3Cl_3 \rightarrow Y(CH_3NH_2)_2Cl_3 + CH_3NH_2$	180
$Y(CH_3NH_2)_2Cl_3 \rightarrow Y(CH_3NH_2)Cl_3 + CH_3NH_2$	232
$Y(CH_3NH_2)Cl_3 \rightarrow YCl_3 + CH_3NH_2$	> 360

WESLEY W. WENDLANDT

Department of Chemistry and Chemical Engineering, Texas Technological College, Lubbock

References

1. A. I. Popov and W. W. Wendlandt, *J. Am. Chem. Soc.* 77, 857 (1955).
2. W. W. Wendlandt, *J. Chem. Educ.* 31, 312 (1954); A. Sieverts, *Z. Metallkunde* 21, 37 (1929).
3. F. H. Spedding, P. E. Porter, J. M. Wright, *J. Am. Chem. Soc.* 74, 2055 (1952).
4. C. T. Kenner and W. A. Felsing, *ibid.* 61, 2457 (1939).

7 March 1955

Frenquel Corrects Certain Cerebral Electrographic Changes

Lysergic acid diethylamide (LSD-25), an alkaloid derived from ergot, produces in human subjects mental disturbances consisting of visual hallucinations and other psychotic symptoms (*1*). This phenomenon has been widely investigated because the psychotic symptoms evoked by LSD-25 are similar to those of schizophrenic patients. Mescaline is another alkaloid long known to produce hallucinations and other psychological and somatic changes like those caused by LSD-25 (*2*). LSD-25 induces, in both experimental animals (*3*) and human beings (*4*), alterations of the electric activity of the brain, consisting of the disappearance or diminution of the slower waves, an increase in the average frequency and of fast low-voltage activity as well as a general diminution of voltage resulting in a flattening of the record.

We studied the effect of mescaline on the electric activity of the rabbit brain and found that it introduces changes that are practically identical with those resulting from LSD-25. It is interesting to note that there is a similarity in the alterations of the electroencephalogram (EEG) induced by these hallucinogenic substances and the records often obtained from schizophrenic patients (*5*). In fact, the choppy rhythm that Davis found in schizophrenic patients consists of low-voltage fast activity accompanied by a poor organization of the alpha rhythm.

The brain electric activity of the curarized, unanesthetized rabbit (the preparation used in the present studies) consists of two fundamental patterns: one, which is seen when the rabbit is undisturbed and resting quietly, consists of slow high-voltage waves and 14-cy/sec spindles; the other, observed when the animal is alerted by a sensory stimulation, reveals fast low-voltage cortical activity with a 4- to 6-cy/sec thalamic rhythm (*6*). This occurs when a neuronal system (mesodiencephalic activating system), which regulates diffusely the electric activity of the brain (*6*), is set into operation.

LSD-25 (10 to 15 μg/kg) and mescaline (10 to 20 mg/kg) induce a change of the electric activity of the brain, consisting in the first place in the elimination of the slow waves and the spindles typical of the resting pattern and, in the second place, in the persistent presence of fast low-voltage activity and the 4- to 6-cy/sec thalamic rhythm, practically identical with the picture that is seen in the alert status (Fig. 1).

Recently Fabing (*7*) reported that the psychotic symptomatology produced in human subjects with hallucinogenic amounts of LSD-25 disappeared after the administration of alpha-4-piperidyl benzhydrol hydrochloride (Frenquel) (*8*). The latter is a new nonhypnotic drug that renders animals less active and in human subjects produces promising results in the management of abnormal mental conditions (*9*).

In our experiments on the rabbit we administered alpha-4-piperidyl benzhydrol hydrochloride intravenously in doses between 8 and 24 mg/kg to animals that had received amounts of LSD-25 or of mescaline sufficient to cause the aforedescribed permanently alert change of

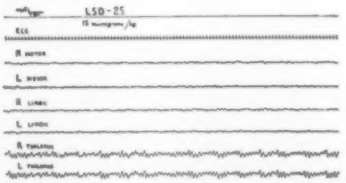


Fig. 1. Effect of LSD-25 on the cerebral electric activity of the rabbit. Notice the low-voltage fast activity in the motor cortex and the thalamic 4- to 6-cy/sec rhythm. Note also the absence of high-voltage slow waves and of spindles. Six monopolar leads from different cerebral structures, as indicated in the figure. Top tracing: electrocardiogram.

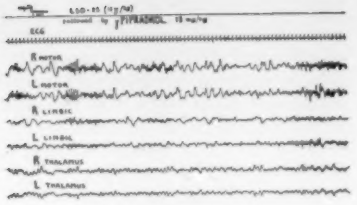


Fig. 2. The abnormalities induced by LSD-25 in the cerebral electric activity of the rabbit are corrected by administration of alpha-4-piperidyl benzhydrol hydrochloride (indicated in the figure as gamma-pipradrol). Notice the reappearance of the high-voltage slow activity and the 14-cy/sec spindles, predominantly in the motor cortex.

the electric brain activity. In all our experiments (five animals with LSD-25, five animals with mescaline) we observed that, within 2 to 10 min after the administration of alpha-4-piperidyl benzhydrol hydrochloride, the normal pattern of brain electric activity was restored. The slow waves and 14-cy/sec spindles, which were eliminated by the hallucinogenic drugs, returned after alpha-4-piperidyl benzhydrol hydrochloride (Fig. 2). The doses of the drug necessary to correct the abnormal electric activity ranged between 12 and 24 mg/kg. We found that there is a direct relationship between the amount of hallucinogen administered and that of alpha-4-piperidyl benzhydrol hydrochloride necessary to reverse the electric changes. Alpha-4-piperidyl benzhydrol hydrochloride when administered alone does not influence the EEG. Neither does it enforce the sleep pattern nor depress the mesodiencephalic activating system, the hyperactivity of which is responsible for the pattern of alertness (*10*).

Di-isopropylfluorophosphate (DFP), amphetamine and Meratran (alpha-2-piperidyl benzhydrol hydrochloride) are other drugs that, like the hallucinogenic substances, evoke a permanent pattern of alertness (*11*). We administered alpha-4-piperidyl benzhydrol hydrochloride to animals that had received enough DFP, amphetamine, and Meratran to produce a continuous alert electric pattern. In no instance, however, did alpha-4-piperidyl benzhydrol hydrochloride correct the effects of DFP, amphetamine, or Meratran, even though the last is a positional isomer of alpha-4-piperidyl benzhydrol hydrochloride. So far it seems that the described action of alpha-4-piperidyl benzhydrol hydrochloride in restoring normal electric patterns in the rabbit is limited to, and perhaps is specific for, the changes induced by the hallucinogenic drugs, LSD-25 and mescaline. Probably the antagonism between alpha-4-piperidyl benzhydrol hydrochloride and the hallucinogenic agents is restricted to the central nervous system, for we have observed that alpha-4-piperidyl benzhydrol hydrochloride does not correct the mydriasis associated with the action of LSD-25 or mescaline. Fabing (*7*) also observed the rectification of the psychic symptoms but not of the autonomic and other physiological alterations wrought by LSD-25.

FRANCO RINALDI*
HAROLD E. HIMWICH
Thudichum Psychiatric Research Laboratory, Galesburg State Research Hospital, Galesburg, Illinois

References and Notes

1. W. A. Stoll, *Schweiz. Arch. Neurol. Psychiat.* 60, 279 (1947).
2. P. H. Hoch, *Am. J. Psychiat.* 107, 607 (1951).
3. J. Delay *et al.*, *Rev. Neurol.* 86, 7 (1952); J. Elkes, C. Elkes, P. B. Bradley, *J. Mental Sci.* 100, 125 (1954).
4. P. B. Bradley, C. Elkes, J. Elkes, *J. Physiol. (London)* 121, 50p (1953); H. Gastaut, S. Ferrer, C. Castells, *Confinia. Neurol.* 13, 102 (1953).
5. P. A. Davis, *Am. J. Psychiat.* 98, 851 (1940); F. Lemere, *Brain* 59, 366 (1936), and *Psychosomat. Med.* 3, 152 (1941).
6. F. Rinaldi and H. E. Himwich, *Arch. Neurol. Psychiat.* 73, 387 (1955); *ibid.* 73, 396 (1955).
7. H. Fabing, *Science* 121, 208 (1955).
8. Frenquel is the trademark of the Wm. S. Merrell Co., Cincinnati, Ohio, for alpha-4-piperidyl benzhydrol hydrochloride.
9. F. Rinaldi *et al.*, in preparation.
10. F. Rinaldi and H. E. Himwich, *Diseases of Nervous System* 16, 45 (1955).
11. ———, *Am. J. Physiol.* 179, 665 (1954).

* Fulbright fellow on leave from the Clinic for the Diseases of the Nervous System, University of Cagliari, Cagliari, Italy.

21 January 1955

Influence of Calcium on Mobility of the Electrophoretic Components of Chicken Blood Serums

The increase in the amount of nondiffusible calcium present in the blood serums of the laying hen has been confirmed many times (*1*). The same relationship has been shown to hold for young hens and cockerels under the influence of the female sex hormones. It has been demonstrated that the serum proteins of the laying hens or hormone-treated birds contain electrophoretic components not present in the serums of the nonlaying birds (*2–4*). Evidence indicating that the variations in the nondiffusible calcium of chicken serums can be associated with the change in concentration of these electrophoretic components has been reported (*5*). A method for measuring P^{32} distribution in the electrophoretic components of protein mixtures has been reported (*6*), and by means of this method it has been shown that the leading component of laying-hen serums and of hormone-injected cockerel serums was extremely rich in phosphorus (*7*).

The high phosphorus content of this leading fraction makes possible the determination of the position of this component under different conditions, even though it may be masked by the fact that it is migrating at the same rate as other components of the serum. By employing the afore-mentioned electrophoretic-radiochemical technique, the effect of increasing concentrations of calcium upon the mobility of this component has been determined (*8*).

The blood serum was prepared from the blood of 8-wk old cockerels injected with 2.0 mg of diethylstilbestrol per day for 5 days. Each chick was fed 0.5 mc of P^{32} daily for 5 days. The electrophoretic (*2*) and radiochemical (*6, 7*) techniques have been described elsewhere. The electrophoreses and previous dialyses were carried out with a borate buffer that contained graded amounts of calcium. The concentrations of calcium employed are indicated in Fig. 1.

When the leading protein fraction was not apparent in the electrophoretic picture but the P^{32} activity associated with it was found to be present in some other fraction, it was assumed that the two fractions were migrating at the same rate. In addition, the areas associated with the electrophoretic components were also determined; when the component containing the extra P^{32} activity had increased in area, the afore-mentioned assumption was considered valid. By this method the mobility associated with this high-phosphorus leading protein component and the other protein components was determined in buffer solutions containing various levels of calcium.

Results of this experiment (Fig. 1) show that the mobility of fraction I, the fastest moving component in buffer containing no calcium, was drastically changed by the addition of calcium to the buffer. The mobilities of the other five

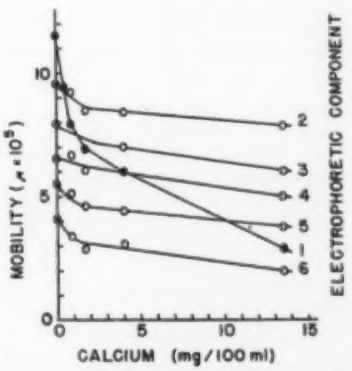


Fig. 1. Mobilities of the electrophoretic components in the serums of diethylstilbestrol-treated cockerels in a borate buffer, *p*H 8.6, containing graded amounts of calcium.

protein fractions were changed but slightly by the presence of calcium in the buffer. This change in mobility of the leading component can be explained by assuming that calcium combined with this component and thus changed the charge of the protein molecule. The result was a marked reduction in the mobility of component 1.

Previous evidence has shown that the rise in the nondiffusible calcium of chicken serum caused by the administration of diethylstilbestrol was paralleled by a rise in two of the electrophoretic components (*5*). This extra binding ability may be attributed to the leading, phosphorus-rich component. Utilizing buffer solutions containing Ca^{45} and an electrophoretic cell modified to determine its activity, we are now investigating the distribution of calcium in the various electrophoretic components of chicken blood serums. A more detailed discussion of this investigation is in preparation.

A. T. Ericson
R. E. Clegg
R. E. Hein
Kansas State College, Manhattan

References and Notes

1. J. T. Correll, and J. S. Hughes, *J. Biol. Chem.* **103**, 511 (1933).
2. L. W. Brandt, R. E. Clegg, A. C. Andrews, *ibid.* **191**, 105 (1951).
3. R. E. Clegg *et al.*, *Science*, **114**, 437 (1951).
4. D. H. Moore, *Endocrinology* **42**, 38 (1948).
5. R. E. Clegg and R. E. Hein *Poultry Sci.* **32**, 867 (1953).
6. R. E. Hein and R. E. Clegg, *Nucleonics*, **10**, No. 10, 70 (1952).
7. R. E. Clegg and R. E. Hein, *Science*, **117**, 714 (1953).
8. This work was aided by a research grant from Eli Lilly Co., Indianapolis, Ind. This paper is contribution No. 515, department of chemistry, Kansas Agricultural Experiment Station. This paper is also a portion of a dissertation to be presented by A. T. E. as partial fulfillment of the requirement for the Ph.D. degree.

25 February 1955

Agglutinating Strains of Trypanosomes Obtained with Oxophenarsine

In the course of producing oxophenarsine-resistant strains of *Trypanosoma equiperdum*, we observed the development of strains with a marked tendency to agglutinate when infected blood containing them was diluted 1:100 with physiological saline in a red-cell-counting pipette at 20° to 30°C (*1*).

The agglutinated masses of trypanosomes, which varied in size up to clumps that contained hundreds of organisms, were so firmly bound together that individual cells did not break away, although they were actively motile. When they were first seen, it was thought that the smaller agglutinated masses represented a failure of cell division, but further observations of the trypanosomes in warm saline (38°C) and in stained, dried blood films proved that the clumps were formed *in vitro*. When warm saline was used and the pipette and counting chamber were warmed to 38°C, the agglutinating tendency was greatly weakened and reliable counts could be obtained, something quite impossible at room temperature. Furthermore, the clumps were dispersed when the pipette in which they were contained was warmed in an incubator at 38°C. This behavior is reminiscent of cold hemagglutination, and cold hemagglutinins have been observed in trypanosomiasis (*2*), but there was no evidence of hemagglutination with serums from mice containing our strains, even at 4°C.

The unmodified strain from which the agglutinating strains were derived was observed in saline at 4°C, and no evidence of agglutination was found. At room temperature the unmodified strain formed evenly dispersed suspensions that were easily counted in a hemocytometer and they showed no tendency to stick together.

All the agglutinating strains have appeared in mice treated with subcurative doses of oxophenarsine when the infection was at levels of 50,000 to 1 million trypanosomes per cubic millimeter of blood. The first strain was obtained on the second day after treatment was started, and other strains developed up to 2 mo after treatment was started. During this period the dose was increased until a strain with 80-fold increased resistance to oxophenarsine was obtained.

In the first strain the agglutinating characteristic persisted in a highly developed form through at least eight passages that were made at 2- to 3-day intervals in untreated mice, but between the 8th and the 17th passages it almost disappeared, being replaced by a predominately nonagglutinating strain. It was possible, however, to recover partially the agglutinating characteristic by centrifuging diluted, infected blood and using the sediment to infect other mice.

On two out of two trials the agglutinating component was destroyed by treating infected mice with somewhat larger doses than the ones that were given just before the strains appeared; their relapse strains were nonagglutinating. Blood obtained from a mouse carrying an agglutinating strain but cleared of trypanosomes by treatment with oxophenarsine did not agglutinate the normal strain. An agglutinating strain was passed to rats, and the characteristic remained well developed in this species.

Although the agglutinating tendency seemed to be related to drug treatment, it was not difficult to obtain highly resistant strains that were completely free of the characteristic by always maintaining several substrains; this was because the incidence of the agglutinating characteristic was relatively low. Most of the mice were treated repeatedly, some as many as 10 times, without inducing any change other than a gradual increase in oxophenarsine resistance.

William Cantrell
Department of Pharmacology, University of Louisville School of Medicine, Louisville, Kentucky

References and Notes

1. This work was aided by a grant to the School of Medicine by the Kentucky State Medical Research Commission and by research grant G-4117 from the National Microbiological Institute of the National Institutes of Health U.S. Public Health Service.
2. *W. Yorke, Ann. Trop. Med. Parasitol.* **4**, 529 (1911).

22 December 1954

Science, Population, and Arid Lands

It is becoming increasingly clear as world population soars to new heights that population pressure aggravates the struggle to maintain high living standards. The outcome of this struggle will depend not alone on available resources but also on the race between population increase and the research that makes resources more usable.

The world population is estimated to have doubled from 100 million to 200 million in the first 1000 years A.D., more than doubled from 500 million to 1200 million in the 200 years from 1650 to 1850, and again doubled from 1200 million to 2400 million in the century from 1850 to 1950. The curve of increase has been rapidly climbing, and if it is projected into the future it promises still higher increase rates.

With such increases, population pressures within densely populated areas are certain to push people into marginal, less densely populated areas. These are mainly the arid lands of the world, where lack of water is the critical factor in making them marginal or less usable in character.

It was shown at the Arid Lands Meeting in New Mexico in late April 1955 that arid zones occupy nearly one-third (32 percent) of the land surface of the earth, and that about 14 percent of the Americas was included. These lands are arid from a variety of causes but mainly because of the planetary wind patterns of the earth, which bring prevailingly dry winds to certain areas. Others lie in the rain shadow of mountains.

Rainfall on arid lands is usually inadequate to produce runoff (except quick heavy showers); hence, most water available in deserts comes in streams from distant mountains or regions of heavier precipitation. Such water, concentrated

in streams, usually requires manipulation by engineering to make it available for human use. Arid lands are especially subject to erosional damage when the sparse cover is disturbed by human use.

One such arid region lies in the southwestern United States. It is comprised of the Great Basin, the Colorado River System drainage, and the Rio Grande drainage areas. The streams in this region do not provide enough water to supply the needs of people who might fill the otherwise habitable portions of the area. The making of homes and communities, the development of mining operations, the needs in industrial uses, and water for irrigation of arid lands can be provided only in part, even with widespread storage and careful efficient use of the water inherent within the area. Much of the land will be doomed perpetually to nonuse or only partial use unless additional water supplies can be provided.

Additional sources of water might lie in the Columbia River Basin, the ocean, or perhaps the Mississippi River Basin. Technology is not far enough advanced at the present time to use the ocean. How long we will have to wait for this source, we do not know. Techniques are available for obtaining water from the Columbia and Mississippi rivers, but until costs of diversion and transmission become economical, they are not likely to be used.

A proposed national attempt to develop the Upper Colorado River for use of part of its waters in the interior states of Utah, Wyoming, Colorado, and New Mexico, an area very difficult to supply from other sources, is now before the Congress of the United States. This proposal unfortunately is being bogged down by diversionary tactics that miss the main point at issue: Shall the arid lands of the interior be made habitable and provide better distribution of dense populations, or shall they be doomed to remain arid with sparse populations?

These diversionary tactics include such questions as apportioning the water between the upper and lower portions of the basin, whether this or that dam site should be used, whether it will improve or ruin recreation, whether we are setting a precedent of invading a national monument, and various other minor matters. All conservation is ultimately directed toward supplying human wants to good advantage and in balanced proportions. Paul B. Sears [*Science* **121**, 5A (29 Apr. 1955)] has called attention to the futility of this political argument.

Would it not be better for the Congress to authorize the development of the river basin, determine the policy of water use, provide funds for operation, and refer minor items of dispute to some fact-finding scientific body for final adjudication, as Sears suggested? There, recommendations or decisions about these items could be made under calm, dispassionate consideration with minimum influence of such emotion-packed articles as "The Wiley and wasteful proposal of the Echo Park Dam" and the "The Echo Park Dam must be stopped." Perhaps even such a proposal as turning water from Yellowstone Lake through the divide into Snake River and diverting it into the Great Basin could be evaluated without the fury of emotional conservationists beclouding the issue.

ANGUS M. WOODBURY
Ecological Research,
University of Utah, Salt Lake City

12 May 1955

Measurement of Activity of Compounds Traced with Low-Energy Beta Emitters

Belcher has described (*1*) a 4π technique for measurement of the activity of β-ray emitters in absolute units. Unfortunately two successive extrapolations are involved—one to zero pulse discrimination, the other to zero source envelope thickness. These extrapolations bring about an uncertainty that is the larger, the lower the energy of the particles. We have thought that, for compounds traced with C^{14} and S^{35} dissolved under low concentrations in highly efficient liquid scintillators, a 4π geometry might, for all purposes, be considered as achieved without the enclosure of the sample in any foil whatsoever; the work reported here was meant to verify this hypothesis.

As a scintillation source we took a mixture of variable proportions of C^{14}-traced and inactive toluene to which was added terphenyl at a concentration of 5 g/lit and traces of α-naphthylphenyloxazole as a wavelength shifter, the emission of which coincides well with the sensitivity of our Electrical Musical Industries (E.M.I.) 6262 photomultiplier. The solution was introduced into a modified version (*2*) of our former sample changer (*3*). The pulses coming from the anode of the photomultiplier were fed through a 100 μμf condenser to our Atomic Instrument 1070 scaler with a 0.1-μsec resolving time; no amplification was required because of the particularly high multiplication factor of our light detector (5×10^8 at a potential difference of 160 v between the dynodes). The number of counts per minute is plotted against the tension applied to the phototube in Fig. 1*a*; the curve shows only an inflexion point at the expected value.

Rosenthal and Anger (*4*)—using C^{14}-labeled cholesterol dissolved in a 5 g/lit solution of terphenyl in xylene to which diphenylhexatriene was added as a wavelength shifter, a Du Mont type K 1177 photomultiplier, a laboratory-made preamplifier, cathode follower, and scaler the description of which is not given—found an effect similar to our own; they considered that it was caused by double-pulsing in their scaler. We have tested our own system with a generator giving pulses of 5-μsec duration and 10-v maximum amplitude at a frequency of 2 kcy/sec; no double pulsing was evidenced.

Wells (*5*), counting Co^{60} gamma rays with stilbene and an E.M.I. 5311 photomultiplier, also found an effect similar to our own; he greatly improved the situation by using a scaler with a 100-μsec resolving time instead of the initial 0.25 μsec and consequently attributed the effect to after-pulses originating in the photomultiplier. Taking this into account we have switched in, before the scaler, a univibrator as described by Chance (*6*) that gives us a discrimination of the pulses controlled by *P* (Fig. 2) and a resolving time of approximately 20 μsec. With such an arrangement we get curves of the type reproduced (for two discriminator settings) in Fig. 1*b*, which shows a characteristic plateau at the expected value of 4400 counts/min.

Table 1 gives the results of measurements made with 10 different activities; the measured values are corrected for

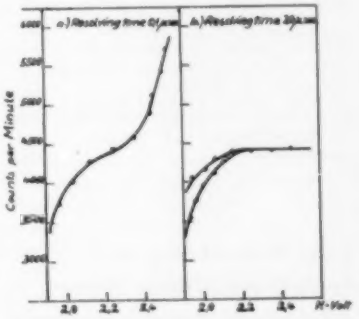


Fig. 1. Variation of counting rate of C^{14} with photomultiplier tension.

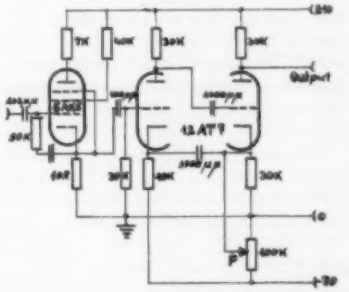


Fig. 2. Univibrator with cathode follower (the input is taken from the anode of the photomultiplier).

Table 1. Results of measurements

Measured values (counts/min)	Actual values (disintegrations/min)	Difference (%)
1,090	1,110	2
2,100	2,220	5
4,490	4,440	1
6,430	6,660	3
9,230	8,880	4
11,550	11,100	4
12,600	13,300	5
15,050	15,500	3
18,200	17,800	2
21.700	22.200	2

background but not for resolving time; the actual values are computed from A.E.R.E. data and our own dilutions; one can see that our precision averages 3.1 percent, which is deemed satisfactory for our purpose. At 100-percent efficiency our background reaches 2000 counts/min; if 1 hr is allowed to measure the sample and a 2-percent relative standard deviation is accepted, 2.0×10^{-10} c can be measured.

JEAN C. ROUCAYROL
ERICH OBERHAUSEN

Université de la Sarre,
Institut de Physique Médicale,
Hombourg, Sarre

References

1. E. H. Belcher, *J. Sci. Instr.* 30, 286 (1953).
2. J. C. Roucayrol and E. Oberhausen, *Naturwissenschaften*, in press.
3. ———, *Compt. rend.* 237, 1680 (1953).
4. D. J. Rosenthal and H. O. Anger, *Rev. Sci. Instr.* 25, 670 (1954).
5. F. H. Wells, *Nucleonics* 10, No. 4, 28 (1952).
6. B. Chance, *Waveforms* (McGraw-Hill, New York, 1949).

7 March 1955

Latex Micro-Molding and Latex-Plaster Molding Mixture

Two refinements of the basic technique for molding objects in liquid rubber—a method for making minutely detailed replicas of small and intricate surfaces and a method for quickly filling undercuts and building up mold thickness—have proved exceedingly useful in research. This discussion is intended to supplement my earlier paper on latex-molding techniques (*1*) and Quinn's basic manual (*2*).

Micro-molding. The process of micro-molding grew out of a need for high-fidelity positive replicas of diminutive Carboniferous amphibian skeletons that are preserved in exquisite detail as natural molds in coal-shale. The replicas must be relatively permanent and suitable for photography and study at magnifications of 30 diameters and greater. They must furthermore be made without damage to the delicate specimens. Such standard methods as making plasteline squeezes fail to meet these requirements, and ordinary latex-molding methods do not fill crevices properly or achieve bubble-free surfaces.

For micro-molding the standard Von Fuehrer latex compound, a thick aqueous suspension of prevulcanized rubber particles, is diluted to the consistency of milk with water previously deaerated by distillation or boiling. I have found an opaque red latex best for study and photography. For optimum surface contact, a liquid detergent such as Rohm & Haas' surface-active agents Tamol N or Triton X-100 (*3*) may be added to the latex or brushed over the surface beforehand. Because of their limited tendency to form bubbles these compounds, particularly the first, have proved superior to the household detergents that are sometimes added to latex (*4*).

The first coat is applied with a small brush or rod moved slowly over the surface so as not to override the advance of the wetting agent; this is done best under a low-power binocular microscope. Latex that collects in depressions should be blown out gently with a blowpipe, and any bubbles that form can be broken by blowing on them. Successive thin layers can be applied hourly and dried by the heat of an electric or an infrared lamp. Deep cavities must be filled gradually with several layers, for a solid plug of latex will shrink as it dries. When the latex coating is thick enough to mask the color of the specimen, a layer of undiluted compound is applied to fill minor depressions. For building up thickness, pure latex or latex-plaster mixture is preferable to inelastic fillers such as cheesecloth.

When the backing coat has dried thoroughly, the mold can be loosened at one corner and carefully peeled. Stretching and flexing the rubber during the peeling process serves to minimize damage to the specimen. For convenience of labeling, handling, and storage, flat molds or casts that will not be used for plaster-casting can be cemented with a little latex to heavy 3 by 5-in. or 5 by 8-in. cards on which the data are typed. The backs of other molds can be labeled indelibly in a contrasting color of dilute latex.

Latex-plaster mixture as filler. The great disadvantage to latex molding is the long drying time required. Backing layers of preshrunk cheesecloth or mixtures of latex with sawdust or ground cork speed the drying only moderately. Plaster of paris, however, makes a highly effective filler and drying agent, since it absorbs moisture both physically and chemically, as water of hydration. The method described here was taught to me by Robert G. Caffrey, sculptor and technician at the Carnegie Museum in Pittsburgh.

Plaster is so active a dehydrator that the mixture must be made in small batches and applied immediately, for it sets in about 1 min. I put a flat dab of latex about the size of a half-dollar on the palm of my hand, dump plaster over it from a small jar, and dump back whatever fails to adhere. The rest is hurriedly mixed with a small spatula and applied to the mold in a layer some 2 mm thick. The proper percentage of plaster varies with the job at hand and the consistency of the latex. The mold surface must be kept free of powdered plaster if succeeding layers are to adhere. Excess compound that solidifies on hands or tools is easily rubbed off.

If mild heat is applied, the mixture dries in an hour or less; when the surface fails to retain a fingernail impression, the next layer may be added. Even in thicknesses of 1 cm or more the mold remains pliable enough to pop out of undercuts and peel easily. With this process, molds may, if necessary, be started and peeled the same day. Heavy and fragile plaster mother-molds are less often needed. The simplicity of these molding methods and the excellent results obtainable should recommend them to workers in several fields.

DONALD BAIRD

Museum of Comparative Zoology,
Harvard University,
Cambridge, Massachusetts

References and Notes

1. D. Baird, *Compass* 28, 339 (1951); reprints available from the Curator, University of Cincinnati Museum, Cincinnati 21, Ohio.
2. J. H. Quinn, *Fieldiana: Technique* 6 (Chicago Natural History Museum, Chicago 5, Ill., ed. 2, 1947), pp. 1–21. Additional references in *Soc. Vertebrate Paleontology News Bull.* 36, 28 (1952).
3. Samples furnished for testing by V. C. Meunier of Rohm & Haas, Philadelphia, are gratefully acknowledged. These compounds are also excellent mold-wetting agents in plaster-casting. A little detergent in the mix water wets plaster quickly, permits increased density by reducing viscosity of the liquid plaster, and improves surface fidelity of casts.
4. M. R. Garner, *Science* 118, 380 (1953).

9 May 1955

Book Reviews

Colchicine—in Agriculture, Medicine, Biology, and Chemistry. O. J. Eigsti and Pierre Dustin, Jr. Iowa State College Press, Ames, 1955. xvii + 470 pp. Illus. $5.

The object of this book, as stated in the preface, is to bring together the significant contributions and correlate the various lines of research concerned with colchicine and its effects on plant and animal cells. A survey of the progress made to date, rather than any prediction of future possibilities, is emphasized.

The text begins with a discussion of the knowledge of *Colchicum* in ancient civilizations and traces its botanical studies from Dioscorides to the 20th century. Medical uses of colchicine, chemical studies of the pure substances, and sources of the drug are fully covered.

In the chapter "New biological uses of colchicine," it is evident that, through meticulous effort, the priority for the discovery of the effect of colchicine on nuclear divisions is credited to Pernice, who described metaphasic arrest in 1889. A medical student, F. Litz, in the laboratory of A. P. Dustin, senior, at Brussels, Belgium, suggested in 1934 the use of colchicine for altering mitosis and in 1937 demonstrated its effect as an agent for inducing polyploidy. After the colchicine bandwagon arrived in 1938, numerous publications appeared in various periodicals around the world. More than 1600 of these references are cited at the close of the 17 different chapters.

Six of these chapters are devoted to descriptions of the effect of colchicine on cytological processes involved in the induction of experimental polyploids, including amphiploids, autoploids, and aneuploids. Criteria for judging polyploidy and methods by which it may be induced are clearly stated and may well serve as a helpful guide for an amateur in the field.

The authors have emphasized the extreme importance of colchicine as a tool for the plant breeder. The reader is fully aware of its usefulness in the improvement of horticultural plants, cereals, fruits, vegetables, field crops, and medicinal plants. Even forest types have been treated with colchicine. These results are included in the text.

The 29 pages of subject index leave much to be desired. Many plants in which polyploidy has been induced are not listed, although some of these may be found in the author index. The arrangement of bibliographic material makes checking difficult. A list of literature cited at the end of each chapter with a supplementary list of references preceding the author index would be preferable.

Colchicine is a book that every person interested in polyploidy should find very helpful, whether he is seeking a method for the induction of ploidy or an explanation of some genetic behavior of polyploids.

CLYDE CHANDLER
Boyce Thompson Institute for Plant Research

A Manual of Paper Chromatography and Paper Electrophoresis. R. J. Block, E. L. Durrum, and G. Zweig. Academic Press, New York, 1955. 484 pp. Illus. $8.

The first section of this manual, written by Block and Zweig, is an unusually complete description of paper chromatography. The mechanics of the techniques are described in such detail that they may seem irrelevant to those familiar with chromatography. However, such detail will prove to be extremely helpful to the student.

The most remarkable attribute of this section is its completeness. Each phase of the assay is dwelt upon at great length. The authors review the advantages of the various forms of chambers, the name and number of the proper filter paper for the clearest separation of different compounds, the best combination of solvents, and the methods for preparing the samples. For each group of compounds there are many reagents given for the location of the spots. For example, in amino-acid chromatography, there are 67 reagents described, including those for specific amino acids. The authors also indicate those that are recommended. Included are the methods that have been described for all biologically important compounds. There are many tables of R_f values.

Unfortunately, the second section by Durrum is not nearly as complete as the first. Durrum explains in the preface that the space allotted prevented a more detailed coverage. This was an unfortunate policy. If a new section was to be added, then it seems to me that the same thorough coverage should be insured. This is not to imply that the second section is poorly done, for such is not the case. However, the word *manual* cannot be applied.

HOWARD B. BENSUSAN
Department of Physiology, University of Maryland School of Medicine

Annual Review of Nuclear Science. vol. 4. James G. Beckerley, Martin D. Kamen, and Leonard I. Schiff, Eds. Annual Reviews, Stanford, Calif., 1954. ix + 483 pp. Illus. $7.

Seventeen essays in this volume cover nuclear physics and biological, chemical, and geologic applications. For me the outstanding review was Kohman and Saito's "Radioactivity in geology and cosmology." A large number of original references are organized into a comprehensive and logically connected survey. Critical selection is exercised without prejudicing problems still in process of solution. In addition, an element of style makes for a relatively exciting article. Another stimulating review is that of Asaro and Perlman on "Alpha radioactivity," which summarizes simply the chief insights and further problems revealed by recent developments. Also enlightening were "Positronium" (De Benedetti and Corben), "Heavy Mesons" (Dilworth, Occhialini, and Scarsi), and "Vertebrate radiobiology" (Thomson).

Unfortunately, a number of the remaining articles were not such a pleasure to read, mainly because of partial neglect of the supposedly dominant review aspect. The object of a review is to survey developments in a field, showing from a single point of view their logical connection, relative importance, and features of general interest. Since the readers are *not* experts, the presentation should remain as simple and basic as possible. All this implies that questions of literary technique, such as organization and style, are more important than they are in an original research paper. It is disappointing to note that some of the papers reviewed here compare unfavorably in perspicuity with papers in the *Physical Review*. This is especially noticeable in the shorter articles, as is to be expected; the more a subject must be compressed without losing coherence, the greater the literary virtuosity required, and the more patent its lack. One recalls Woodrow Wilson's remark on the 5-minute versus the 2-hour speech.

The writing of a satisfactory review article demands extra effort; but under the present tendency toward fragmentation of research, this effort appears to be of increasing value as a means for scientific workers to keep from becoming ignorant of science.

D. C. Peaslee

Department of Physics,
Purdue University

Les Bactéries Lysogènes et la Notion de Provirus. F. Jacob, Monogr. de l'Institut Pasteur. Masson, Paris, 1954. viii + 176 pp. Illus. + plates. Paper, F. 800.

This monograph contains a detailed description of the remarkable researches that have been carried out in the division of Microbial Physiology of the Pasteur Institute since 1950, studies that have placed the phenomenon of lysogenesis in clear relationship to other aspects of bacterial virology. Included are investigations of the bacteriocins, antibiotics that have certain important properties in common with bacteriophages. Prophages, the latent form of phages in lysogenic bacteria, are extensively considered with respect to their nature and their relationship to the genetic material of the bacterial host cell. This is followed by an enlightening discussion of provirus as a possible explanation of viral latency in animals and plants.

This book will be read with pleasure by all those interested in bacteriophages. It may be read with profit by those interested in plant and animal viruses and, in addition, is heartily recommended to all biologists as an example of the way in which research in an esoteric field may illuminate other branches of biology.

Mark H. Adams

Department of Microbiology,
New York University

Differential and Integral Calculus. Harold M. Bacon. McGraw-Hill, New York–London, ed. 2, 1955. vii + 547 pp. Illus. $6.

Since Granville's *Elements of the Differential and Integral Calculus* first appeared in 1911, the traditional sophomore course has changed little. Neither arrangement nor presentation of topics in textbooks on the calculus has been significantly different. The revised edition of Bacon's *Differential and Integral Calculus* carries on the tradition.

However, a few calculus textbooks have appeared in recent years that are different. The authors of these textbooks attempt to give the calculus the flavor of contemporary mathematics. One would expect that a revised edition of a "well-liked text" would try to incorporate also some of the concepts of contemporary mathematics. But one looks in vain for evidence. On page 5, for example, is given the usual, unsatisfactory definition of a variable as "a quantity that may have different values," and on the same page one finds that "a *constant* is a quantity that retains the same value throughout any given problem or discussion." In view of the way in which the author handles variable and constant, one is not surprised by the sentence on page 209: "Since the value . . . is perfectly arbitrary, we call [it] an *arbitrary constant*."

There appears no hint of a contemporary definition of a function. Since several freshman textbooks include a development of a modern concept of a function, there is a feeling of disappointment that a more advanced textbook chooses to ignore this important aspect of mathematics.

Myron F. Rosskopf

Department of the Teaching of Mathematics, Teachers College,
Columbia University

Advanced Mathematics for Engineers. H. W. Reddick and F. H. Miller. Wiley, New York–London, ed. 3, 1955. xiv + 548 pp. Illus. $6.50.

This is the third edition of a book first published in 1938. It is based on courses given by the authors to engineering students at the Cooper Union Institute of Technology and is designed to set forth many of the roles played by advanced mathematics in the technology of civil, electrical, mechanical, and chemical engineering. The third edition was prepared by F. H. Miller.

This edition differs from the second principally in a fuller treatment of Legendre functions; in the shortening of the discussion of permutations, combinations, and elementary probability theory to secure space for a short treatment of numerical methods for solving differential equations; and in the inclusion of a section on Laplace transforms. Like its predecessors, the book devotes several chapters specifically to a discussion of differential equations and includes many examples involving differential equations in the other chapters. It is expected that the recurrence of such problems will provide the student with as full a knowledge of the theory and applications of this discipline as is usually obtained in a separate course.

In my opinion, the view is overly optimistic. The importance of a secure knowledge of differential equations for engineering students is such that a full course supplemented by work selected from other chapters of this book would seem to constitute a preferable procedure. This possibility is contemplated by the authors, and the book can easily be adapted to such an arrangement.

The very brief space devoted to probability theory in the revised Chapter IX seems hardly adequate to justify its inclusion in the book, while the introduction to numerical solutions of both ordinary and partial differential equations is necessarily also extremely brief. It would require an extraordinarily competent teacher to give the student an understanding of the content of the problems alluded to in this chapter.

This is a difficulty, of course, that presents itself in connection with most topics presented in a book of this length that deals with differential equations, ordinary and partial; hyperbolic functions; elliptic integrals; Fourier series; Gamma, Bessel, and Legendre functions; vector analysis; probability and numerical methods; functions of a complex variable; and operational calculus.

The difficulty of handling such a variety of topics is minimized by a consistently clear and careful exposition, supplemented by adequate footnote references to mathematical articles and books. With each principal topic, examples are presented in the text dealing with physical applications related to the four main fields of engineering; and extensive and interesting problem material is included.

Mina Rees

Hunter College

Magnetic Amplifiers. H. F. Storm. Wiley, New York; Chapman & Hall, London, 1955. xix + 545 pp. Illus. $13.50.

This book comprises a preface, a detailed table of contents, 29 chapters, an extensive bibliography, and a good index. The first three chapters treat magnetic materials and the measurement of their characteristics. Chapters 4–20 and 29 are devoted to the theory of operation of saturable reactors, magnetic amplifiers, and nonlinear inductors. Details of magnetic amplifier construction are presented in Chapter 21, characteristics of metallic rectifiers are presented in Chapter 22, and numerous practical applications of magnetic amplifiers are mentioned in Chapters 23–28.

The book is very well bound, excellently printed, and profusely illustrated with extraordinarily good drawings. The style of writing is such as to be easily

understood, and care is taken to explain clearly points that ordinarily tend to be difficult for the student to grasp. However, in some instances the author's statements are not as precise as might be desired.

The comprehensiveness of coverage of the theory of magnetic amplifiers tends to make this book well suited for use as a textbook in a senior-level course in electrical engineering. The complete lack of problems and the relatively great expense of the book resulting from the inclusion of a large amount of material that would be wholly out of place in such a course tend to detract from the value of the book for class use. Specifically, the material on testing of magnetic materials and on the construction of magnetic amplifiers has no place in a course of such nature; furthermore, because of an almost complete lack of application of the concepts of transfer function and the mathematical analysis developed in Chapters 4–20, the discussions of applications in Chapters 23–28 have little value for a senior-level course.

However, this book should serve as an excellent reference book for the practicing engineer and the senior student alike.

GORDON J. MURPHY
Electrical Engineering Department, University of Minnesota

Physicochemical Calculations. E. A. Guggenheim and J. E. Prue. Series in Physics. J. De Boer, H. Brinkman, and H. B. G. Casimir, Eds. Interscience, New York; North-Holland, Amsterdam, 1955. xii + 491 pp. Illus. $7.

Physicochemical Calculations will fill a real need for a modern source book on the details of physicochemical computations long felt by physical chemistry teachers and by research workers in this area. The book contains 171 problems based on published work in physical chemistry or chemical physics. Each problem is presented in four sections: namely, data, including detailed references to the sources; procedure, which describes the method of calculation; detailed numerical calculation, paying particular attention to units; discussion of significance of the result and the relation to other work.

The problems are divided into 24 groups on the basis of their subject matter. These groups are atomic and molecular weights, Avogadro number, molecular velocities, interatomic distances, moments of inertia, characteristic frequencies, electric moments and polarizabilities, energies and enthalpies, entropies, heat capacities, equation of state, mixtures of nonelectrolytes, electrolyte solutions, conductance and diffusion of electrolytes, gaseous equilibria, chemical equilibria involving solids, solution equilibria, acid-base equilibria, general electrolyte equilibria, solid surfaces, liquid surfaces, gas kinetics, solution kinetics, radioactivity.

As may be seen from the list of subjects, there is material that will be valuable to the student and the practitioner of physical chemistry at all levels. We are indebted to the authors for their painstaking effort.

ARTHUR TOBOLSKY
Department of Chemistry, Princeton University

Enzymologie. Eine Darstellung für Chemiker, Biologen und Mediziner. Otto Hoffmann-Ostenhof. Springer, Vienna, 1954. xvi + 772 pp. Illus. $26.65.

This book is an expansion of a two-semester course in enzymology for advanced students of chemistry given by the author at the University of Vienna. The first 17 chapters (175 pages) deal with general aspects of enzyme chemistry —history, kinetics, general methods of purification, thermodynamic considerations, analytic procedures employed to follow enzymatic reactions, and so forth. These subjects are not treated extensively, but the material should be useful to a beginning student in this field.

A separate chapter has been devoted to nomenclature, a specialty of the author; in fact the author's method of nomenclature for enzymes is used throughout the book. To give a few examples, D-amino acid oxidase is called D-amino acid $\rightarrow O_2$-transdehydrogenase, DPN-cytochrome c-reductase becomes DPN $\cdot H_2 \rightarrow$ cytochrome c-transelectronase, and phosphorylase is glucose-1-phosphate $\longrightarrow$ amylose-transglucosidase. In some cases, even though much is known about substrate specificity and the mode of action of the enzyme, it has been impossible to arrive at a systematic name, and the author has retained the trivial name of the enzyme, for example, pepsin, trypsin, papain. For those less adventuresome in the matter of nomenclature, the traditional name can be found in parentheses in the text or index. Some readers may consider it a minor annoyance to find the traditional name of an enzyme in the index and there cross-referenced to the author's terminology before finding the page number.

Chapters 18 to 47 (497 pages) contain discussions on the properties of individual enzymes; this portion of the text assumes the proportions of a *Handbuch*. The treatment of the individual biocatalysts is, of course, not as extensive as in a treatise such as *The Enzymes*, but the author has certainly made an effort to include pertinent facts concerning as many enzymes as possible. Literature references, frequently up to 1953, are included in each discussion. In the attempt to make the book as current as possible there has been an occasional presentation of certain material as fact which is still in the realm of theory. For example, on page 166 coA-phosphate is stated to be the intermediate of Kaufman's P-enzyme reaction.

The material in the book is well organized, and the descriptive parts are presented in a concise manner. The section of the text dealing with the individual enzymes should be helpful as a reference source for the student of enzymology.

G. W. E. PLAUT
Department of Biochemistry, New York University College of Medicine

The Biology of Man. John S. Hensill. With chapters by Joel F. Gustafson and Herman Zaiman. Blakiston, New York, ed. 3, 1954 (Order from McGraw-Hill, New York). vii + 440 pp. Illus. $5.50.

The present book was developed by the author for use in a program in general education. He states his objectives as follows: "This book is planned to achieve several objectives which will give the student a fuller, richer life through an understanding of his own fundamental nature: (1) to understand the relation of other organisms to, and the effects of other organisms on, the human organism; (2) to understand the normal and some of the abnormal processes involved in the origin and development of human life; (3) to understand the mechanism by which human characteristics are, or are not, inherited; and (4) to understand and appreciate the place, force, and significance of biological science in our modern society. Through these the student accumulates a background of information about the one subject that interests him most, himself."

This presentation is a far cry from the older "health and hygiene" approach. Fundamental information is intelligently presented in a manner that develops recent physiological principles. If the student assimilates this information, he will possess an understanding of his anatomical and physiological self, attained by few college students. The presentation of chemical information necessary for understanding physiological activity is mature but not beyond the capabilities of the average college student. Except for a greater stress upon human character-

istics than is usually found in introductory biology textbooks, the presentation of heredity offers little that is unique.

Evolutionary relationships and disease relationships of organisms to man are adequately discussed. Most biologists will undoubtedly wish to see greater space devoted to affinities between plants and man and the invertebrates and man. The force and significance of biological science on our modern society is left for the instructor to develop, or it is assumed that the student will make these relationships for himself.

Where man is the focus of biological study, and where fundamental information is required in a course of biology, this book rates serious consideration.

LELAND P. JOHNSON
Department of Biology, Drake University

Statistical Problems of the Kinsey Report on Sexual Behavior in the Human Male. W. G. Cochran, F. Mosteller, and J. W. Tukey. American Statistical Assoc., Washington, 1954. x + 338 pp.

This volume contains a critique, by a committee of the American Statistical Association, of the methodological aspects of Kinsey's *Sexual Behavior in the Human Male*. A 42-page concise summary of the issues is followed by a series of appendixes in which are found detailed accounts.

Appendix A (110 pages) is a reproduction and evaluation of six leading reviews (in journals) of Kinsey's book. In general, these three mathematical statisticians agree with the previous critics, who had pointed out many serious shortcomings in Kinsey's methods. In Appendix B, prepared by W. O. Jenkins (a psychologist), one finds that by comparison with the eight other most important sex studies the work of Kinsey is superior, even though far from perfect.

The remaining five appendixes are concerned primarily with the problems of sampling and statistical treatment of results. Because of refusals, it becomes very difficult, even with true probability sampling, to arrive at precise percentages and averages for sexual behaviors. Refusals increase the width of confidence limits so much that if x dollars are required to get a nonrefuser, it may be worth more than $10x$ dollars to persuade a refuser to respond.

This book should become required reading for sociologists, psychologists, and others who must depend on sampling surveys of human populations.

QUINN MCNEMAR
Department of Psychology, Stanford University

Health Careers Guidebook. National Health Council, New York, 1955. 153 pp. Illus.

This 156 page book is the most attractive and interesting guidance aid that has appeared for the field of the health vocations and careers. It is intended for use primarily in high schools and junior colleges, by school principals and vocational guidance counselors. It will also certainly be consulted by many students themselves, since it contains concise, factual descriptions of some 156 occupations in health services. Although it does not claim to be comprehensive, it does cover a wide variety of careers, such as laboratory technologist, pharmacist, medical librarian, special therapists, nurse, physician, statistician, administrator, and veterinarian. Prominently displayed are numerous organizations and their addresses, from which additional information is available.

Also included is an all-too-brief section on basic sciences in the health field. This is an excellent introduction to what should be a book as large as the present one devoted entirely to the highly skilled professional and scientific careers in the life sciences, all of which are important in the health field.

Biologists have been slow to realize the need for "promoting" their science at secondary-school levels, despite the fact that today many of our most gifted young people are seeking career guidance while they are in junior- or senior-high schools. More informational material, as well written and as attractively designed as this guidebook on health careers, is needed.

MILTON O. LEE
Federation of American Societies for Experimental Biology

Genetica Medica. Primum Symposium Internationale Geneticae Medicae 6–7 Sept. 1953. Luigi Gedda, Ed. Edizioni dell'Istituto Gregorio Mendel, Rome, 1954. xxiii + 467 pp. Illus. + plates. L. 5.000.

There are two types of international scientific meetings: those that are "international" by virtue of their being sponsored and organized by an internationally recognized agency, and those that receive this qualification from the person who decides to invite to his laboratory a number of colleagues from various countries. The "Primum Symposium Internationale Geneticae Medicae" belongs to the second type; the book under review contains the proceedings of this meeting on medical genetics, held in Rome in 1953.

Of the 12 invited and the 18 contributed papers, presented in the original language, there are a few of considerable interest, such as that by R. Ceppellini on hereditary conditions responsible for urinary excretion of amino acids, and that by A. Franceschetti and D. Klein on the identification of heterozygotes.

In the opening address of Luigi Gedda, the organizer of the symposium, as well as in a short talk by a physiologist, C. Foà, there are polemic remarks claiming that the study of human genetics should be the domain of physicians. Of course, no geneticist would deny the right of medical doctors to devote themselves to human genetics, and, in fact, important contributions to the science of heredity have been made by professional physicians. They, however, should at least take the trouble to learn the proper use of terms, in order not to confuse, for example, inbreeding with backcrossing (p. 13) or chromosome markers with closely linked genes (p. 448).

Th. Dobzhansky [*Science* **118,** 561 (1953)] has already commented on the introductory section of the volume, an allocution of His Holiness Pope Pius XII to the participants in this symposium. It is interesting to note that Gedda has found it necessary to reply to Dobzhansky's criticisms in a footnote to the allocution where it is stated: "In this allocution, the concept of species is taken in the philosophico-biological sense, signifying that one may speak of a new species, when not only the quantitative and qualitative elements, but also at least one ontological element, are different." One would expect from Gedda, the head of the Men of Catholic Action of Italy, a greater respect for the words of His Holiness than is apparent from the sometimes incorrect translations into English, German, and Italian of the allocution, which was originally delivered in French.

ADRIANO A. BUZZATI-TRAVERSO
Scripps Institution of Oceanography

Nuclear Physics. Alex E. S. Green. International Series in Pure and Applied Physics. Leonard I. Schiff, Consulting Ed. McGraw-Hill, New York–London, 1955. xv + 535 pp. Illus. $9.

This book was written primarily as a textbook for a course in nuclear physics for senior or first-year graduate students. Although a knowledge of atomic physics and quantum mechanics has not been assumed, a reader with a background that includes these subjects will probably derive more from the book.

The first two chapters are concerned with relativistic dynamics, a review of

atomic physics, and a decription of the static properties of nuclei. In Chapter 3 are the major types of particle accelerators. The characteristics of a typical machine of each variety are tabulated. Chapters 4 and 5 are devoted to experimental instruments and methods. This is a very complete summary. One minor objection to this section is the inclusion of rather complex diagrams of apparatus from the literature without sufficient accompanying explanations. The next two chapters are an introduction to radioactivity and nuclear reactions. Chapter 8 is a discussion of systematics and the general characteristics of nuclear forces. A chapter then is devoted to the liquid-drop model and fission.

Before the development of nuclear theory, there is an introduction to quantum mechanics that should prove helpful to the student at this point. Some of the topics in nuclear theory that are then included are the major models, nuclear moments, radiative transitions, alpha and beta decay. The last two chapters are devoted to the theory of nuclear reactions and nuclear forces.

Perhaps the most outstanding feature of the book is its completeness. The arrangement of material is, for the most part, very good. There is a set of problems at the end of each chapter that are designated according to their complexity. The book in general is well referenced, and a list of these references is included at the end of each chapter.

In summary, *Nuclear Physics* should be welcomed by those teaching a course in the subject, since there are few textbooks written at this level that are so comprehensive and lucid. Others involved in nuclear physics should be equally pleased to have this as a reference book, since it brings together a vast amount of up-to-date information on the subject.

J. J. KRAUSHAAR
Department of Physics,
Stanford University

Books Reviewed in The Scientific Monthly

August

Exploring Mars, Robert S. Richardson (McGraw-Hill). Reviewed by Thomas S. Gardner.

Soil, G. V. Jacks (Philosophical Library). Reviewed by C. E. Millar.

The Origins of Psychoanalysis, Marie Bonaparte, Anna Freud, and Ernst Kris, Eds. (Basic Books). Revised by Robert R. Holt.

Public Education under Criticism, C. Winfield Scott and Clyde M. Hill, Eds. (Prentice-Hall). Reviewed by John R. Mayor.

Suicide and Homicide, Andrew F. Henry and James F. Short, Jr. (Free Press). Reviewed by Dorothy S. Thomas.

Cryptogamic Botany, Gilbert M. Smith (McGraw-Hill). Reviewed by H. L. Blomquist.

Forest Entomology in Hawaii. Otto H. Swezey (Bernice P. Bishop Museum). Reviewed by F. R. Fosberg.

Poliomyelitis, World Health Organization (WHO). Reviewed by Robert Ward.

The Nihilism of John Dewey, Paul K. Crosser (Philosophical Library). Reviewed by James P. Warbasse.

50 Jahre Arzneimittel Forschung, C. L. Lautenschläger (Thieme). Reviewed by Glenn L. Jenkins.

A Field Guide to Animal Tracks, Olaus J. Murie (Houghton Mifflin). Reviewed by Frank A. Pitelka.

How to Know the Minerals and Rocks, Richard M. Pearl (McGraw-Hill). Reviewed by Victor T. Allen.

A Guide to the Planets, Patrick Moore (Norton). Reviewed by Harlow Shapley.

Aspects of Deep Sea Biology, N. B. Marshall (Philosophical Library). Reviewed by Joel W. Hedgpeth.

The Micmac Indians of Eastern Canada, Wilson D. Wallis and Ruth Sawtell Wallis (Univ. of Minnesota Press). Reviewed by Matthew W. Stirling.

Laboratory Instrumentation in Psychology, William W. Grings (National Press). Reviewed by Lester N. Recktenwald.

New Books

Man's Mastery of Malaria. Paul F. Russell. Oxford Univ. Press, New York–London, 1955. 308 pp. $6.

F. Schuyler Mathews' Field Book of American Wild Flowers. Rev. and enlarged by Norman Taylor. Putnam, New York, ed. 4, 1955. 601 pp. Illus. $5.

Applied Thermodynamics. Formerly *Heat Power.* Earle B. Norris, Eric Therkelsen, and Clarence E. Trent. Mc-Graw-Hill, New York–London, ed. 3, 1955. 490 pp. $7.50.

The Structural Relations of Natural Products. Being the First Weizmann Memorial Lectures, December, 1953. Robert Robinson. Oxford Univ. Press, New York–London, 1955. 150 pp. $4.

Advanced Calculus. An introduction to classical analysis. Louis Brand. Wiley, New York; Chapman & Hall, London, 1955. 574 pp. $8.50.

Danger My Ally. F. A. Mitchell-Hedges. Little, Brown, Boston, 1955. 278 pp. $3.75.

Blutgerinnungsfaktoren. Band I. Erwin Deutsch. Deuticke, Wien, 1955. 298 pp. DM. 42.

Radiocarbon Dating. Willard F. Libby. Univ. of Chicago Press, Chicago, ed. 2, 1955. 175 pp. $4.50.

European Firearms. J. F. Hayward. Philosophical Library, New York, 1955. 53 pp. $7.50.

Merchant Ships: World Built. 1955 volume. De Graff, New York, 1955. 264 pp. $5.

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, but to the publishers or agency sponsoring the publication.)

Annual Report, 1954, of the Twentieth Century Fund. The Fund, New York, 1955. 62 pp.

Mite Pests of Ornamentals and Their Control. Bull. 591. John C. Schread. Connecticut Agr. Expt. Sta., New Haven, 1955. 19 pp.

Malaria: A World Problem. E. J. Pampana and P. F. Russell. World Health Organization, Geneva, 1955. 72 pp. $0.70.

Proceedings. vol. LVIII, No. 1. Ser. A, *Mathematical Sciences,* 131 pp.; ser. B, *Physical Sciences,* 89 pp.; ser. C. *Biological and Medical Sciences,* 136 pp. **Proceedings.** vol. LVIII, No. 2. Ser. A, *Mathematical Sciences,* 128 pp.; ser. B, *Physical Sciences,* 56 pp.; ser. C, *Biological and Medical Sciences,* 136 pp. Koninklijke Nederlandse Akademie van Wetenschappen, North-Holland, Amsterdam, 1955.

Rice Varieties and Their Yields in Arkansas, 1948–1954. Rpt. ser. 49. T. H. Johnston and E. M. Cralley. Agr. Expt. Sta., Univ. of Arkansas, Fayetteville, 1955. 20 pp.

Subcommittee Report on Research Activities in the Department of Defense and Defense Related Agencies. Dept. of Defense, 1955 (Order from Supt. of Documents, GPO, Washington, D.C.). 91 pp. $0.30.

Report on Inspection Commercial Feeding Stuffs 1954. Bull. 592. H. J. Fisher. Connecticut Agr. Expt. Sta., New Haven, 1955. 116 pp.

Visual Sensations (Phosphenes) Produced by AC Sine Wave Stimulation. Johs. Clausen. Munksgaard, Copenhagen, 1955. 101 pp.

Calibration of the Weights in Balances with Automatic Weight Loading. Natl. Standards Lab. Tech. Paper No. 6. G. A. Bell. Commonwealth Scientific and Industrial Research Organization, Melbourne, Australia, 1955. 8 pp.

List of the Plants of N. W. Europe. vol. 1, *Vascular Plants.* Nils Hylander. Lund Botanical Soc., Lund, Sweden, 1955. Kr. 4.50.

Report of the Committee on the Measurement of Geologic Time 1953–1954. Div. of Earth Sciences, Publ. 333. 193 pp. $1.75. **Vehicle Climbing Lanes.** Highway Research Bd., Bull. 104. 34 pp. $0.60. Natl. Acad. of Sciences–Natl. Research Council, Washington, D.C., 1955.

The Megachiline Bees of California (Hymenoptera: Megachilidae). Bull. of California Insect Survey, vol. 3. Paul D. Hurd, Jr., and Charles D. Michener. Univ. of California Press, Berkeley and Los Angeles, 1955. 247 pp. $3.50.

Rusts and Wood-Rotting Fungi on Some of the Important Indian Conifers. Indian Forest Bull. No. 179. Y. N. Puri-Manager of Publications, Delhi, 1955. 10 pp. 1s.

Developed and Potential Waterpower of the United States and Other Countries of the World, December 1954. Circ. 367. Loyd L. Young. Geological Survey, Washington 25, 1955. 14 pp.

Scientific Meetings

Fatigue of Metals

A colloquium on the fatigue of metals was held at the Royal Technological Institute, Stockholm, 25–27 May, under the sponsorship of the International Union of Theoretical and Applied Mechanics and with financial assistance from UNESCO via the International Council of Scientific Unions, the Swedish Government, and Swedish industrial firms.

Papers were presented by 37 authors from Denmark, Finland, France, Germany, Holland, Italy, Norway, the Saar, Sweden, Switzerland, the United Kingdom, the United States and the U.S.S.R.

W. Weibull (Sweden) began the colloquium by proposing to consider the fatigue process in two stages—first, the initiation of a crack; and second, the propagation of the crack. Weibull showed some data for which the velocity of crack propagation was independent of crack length in a given notched specimen and increased in direct proportion to the specimen width. Thus the time of propagation is independent of the specimen dimensions. The scatter in these results was very small. On the other hand, the number of cycles to the appearance of the first crack of a given small length exhibits great scatter and a size effect.

The subject of crack propagation appeared in other papers and the data were not wholly consistent with those of Weibull. R. B. Heywood (United Kingdom) presented some data in a much larger specimen which showed an increase in velocity of propagation. In both sets of data the load was continually readjusted to give constant stress on the undamaged section. C. E. Phillips (United Kingdom) described the appearance of fatigue cracks in notched specimens at a small number of cycles which do not propagate further at the same stress. His explanation was that the crack propagated in the stress field until the stress fell to the level of the fatigue limit.

Other participants thought the cracks relieved initial stresses in the specimen. Some evidence was presented to show that a fatigue crack is not as effective as a stress raiser as is a notch of considerably greater radius at the apex or root. Phillips believes that the maximum stress in the stress cycle is the predominant factor in crack propagation, and that positive values of mean stress have a large effect. Cracks appear to propagate under maximum principal shear stress when microscopically examined, even in those cases where microscopically they appear to propagate under maximum principal tension.

C. Schaub (Sweden) advanced the hypothesis that fatigue failure requires the simultaneous action of imposed alternating stresses and a reaction-kinetic process of the surface material that has been activated by slip with the surrounding medium. His paper stimulated extensive discussions.

Several papers dealt with cumulative damage, but the discussion was somewhat confusing, in that the term *damage* was used in various meanings, often without clear quantitative definition. There was general agreement that the Miner hypothesis was not generally applicable.

E. Gassner (Germany) described some fatigue experiments with randomly varying loads reproducing the magnitudes and frequencies to be expected in service. Attempts were made to determine the influence of small stress amplitudes far below the endurance limit.

I. A. Oding (U.S.S.R.) discussed the mechanism of fatigue failure in terms of dislocation theory. He quoted experimental results on the torsional endurance limit σ_0 with zero mean stress and the torsional endurance limit σ_w when a steady stress σ_0 was present. The results supported the relation $\sigma_w^2 = \sigma_a^2 + \sigma_a \sigma_0$.

Heywood described a substantial improvement in the fatigue strength of aircraft structural elements through the application of a very high static load prior to the fatigue test.

A. S. Petrusevich (U.S.S.R.) called attention to the puzzling fact that in contact fatigue between cylinders, cracks begin at the surface rather than at points below the surface where the stresses are higher. In the discussion, the large influence of lubricants was described, as well as experiments in which attempts were made to inspect for cracks below the surface by ultrasonic techniques.

A paper by G. V. Uchik (U.S.S.R.) presented a theory of fatigue based on considerations of the effect of repeated microplastic flow in the vicinity of stress concentrations, stress redistributions, and similar considerations.

■ A World Conference of Scientists will be held in London, 3–5 Aug., under the sponsorship of the World Association of Parliamentarians for World Government. The purpose of the conference is to enable world scientists to discuss the nature and extent of the danger to mankind involved in experiments with nuclear weapons and their possible use in warfare. Officers of the association are Boyd Orr, honorary pres.; Clement Davies, pres.; and Gilbert McAllister, sec.-general. Headquarters are maintained at 21 Hampstead Lane, Highgate Village, London.

■ The 4th annual symposium on Industrial Applications of X-ray Analyses will be held 11–12 Aug. at the Albany Hotel, Denver, Colo. The symposium is sponsored by the Denver Research Institute, University of Denver.

■ The 10th International Congress of Entomology will be held in Montreal, 17–25 Aug. Following the congress, a number of excursions to places of entomological interest will be arranged. For further information, those planning to attend the congress should communicate as soon as possible with the secretary, Mr. J. A. Downes, Division of Entomology, Science Service Building, Ottawa, Ontario, Canada.

■ The 18th meeting of the Meteoritical Society will be held 12–13 Sept. at the Institute of Meteoritics of the University of New Mexico, Albuquerque. All scientific sessions of the meeting will be open to the public. The chairman of the program committee is Lincoln LaPaz, director of the institute.

■ The 10th annual Ohio State Fire School will be held 12–16 Sept. at Ohio State University and will be conducted simultaneously with a separate school, also on the campus, for arson investigators. Seven state-wide organizations interested in firefighting and fire prevention join with the university in sponsoring the annual school. Inquiries about enrollment should be sent to Charles L. Scott, State Fire Marshal Wyandotte Bldg., Columbus, Ohio.

■ In conjunction with the Atomic Industrial Forum's fall meeting, a trade fair will be held in Washington, D.C., 26–30 Sept., to demonstrate the extent to which peaceful uses of atomic energy and its associate products and services have advanced as an important sector of our industrial economy. The fair will be attended by officials of organizations engaged or considering participation in atomic energy development and use, members of the Congress, the staffs of interested government agencies, and the

commercial and scientific attachés of various embassies and legations.

Exhibits will be displayed in such fields as design engineering, package power, medical and research reactors, control systems, reactor materials, instrumentation, construction and fabrication techniques, isotope sources and applications, shielding materials and devices, and reactor components and auxiliaries.

■ Arrangements for the Nuclear Engineering and Science Congress to be held in Cleveland, 12–16 Dec., are being coordinated by the Engineers Joint Council under the leadership of Thorndike Saville, dean of the College of Engineering, New York University, and president of EJC. Nearly 300 papers covering practically every phase of the peacetime uses of atomic energy and its by-products are scheduled for presentation by U.S. and foreign participants from 24 business and technical societies, 16 universities, 13 government bureaus and AEC contractors, and 34 major U.S. industrial corporations.

Representatives of the 29 participating societies, whose membership totals more than 400,000, have approved plans for 50 technical sessions, with as many as five separate sessions being held simultaneously. A special committee headed by John R. Dunning, chairman of the General Committee on Nuclear Engineering and Science and dean of engineering at Columbia University, is making arrangements for an all-congress session.

Under the chairmanship of Donald L. Katz, head of the chemical and metallurgical engineering department at the University of Michigan, the program committee has grouped the papers to be presented into 50 general topic headings. They include the "where and how" of atomic power plants, with emphasis on safety and selection of site; radiation hazards and their controls; pros and cons of the varied proposed power-plant types; atomic reactors for research purposes and radiation laboratories; radioisotopes and tracer techniques for industry, medicine and agriculture; disposal of radioactive waste; what to do about radioactive fallout; and uranium geology.

While the technical sessions are underway at the Cleveland Public Auditorium, leading U.S. and foreign industrial firms that are working on developing atomic energy for industry, medicine, and agriculture will display in the auditorium's five exhibit halls special equipment developed for peacetime uses of the atom. Sponsored by the American Institute of Chemical Engineers and headed by Barnett F. Dodge of Yale University, this first International Atomic Exposition will feature reactor models of the latest design; specially designed "mechanical hands" and their controls, which can be operated with great accuracy to handle the "hot" materials encountered in atomic installations; closed-circuit television, a vital accessory to many of these installations; and newly developed alloys and materials that have properties essential for use in radioactive installations. The exposition will be open to the general public on 10–11 Dec. and in the evenings from 12–16 Dec. Representatives of industry, medicine, and agriculture may attend from 12–16 Dec. during the day. Registrants to the congress may visit the exposition at any time.

■ "Endocrinology and metabolism" will be the subject for the 7th annual Postgraduate Assembly of the Endocrine Society, to be held 26 Sept.–1 Oct. at Indianapolis with the cooperation of the Indiana University School of Medicine. Continuation study facilities of the Indiana University Medical Center will be utilized for the sessions, at which 21 leading clinicians and investigators will be heard. Information regarding the program and registration may be obtained from the Postgraduate Office, Indiana University School of Medicine, 1100 W. Michigan, Indianapolis 7, Ind.

■ The 3rd annual meeting of the Inter-Society Cytology Council will be held at the Statler Hotel, Cleveland, Ohio, 11–12 Nov. Morning and afternoon sessions will be devoted to the scientific program, which will include 16 formal papers and 9 round-table discussions of cytological problems. The scientific program will comprise four sections: (i) new advancements in cytology; (ii) applied cytology; (iii) round table discussions; (iv) a symposium on the problems of early endometrial cancer. Additional information may be obtained from Dr. Paul F. Fletcher, 634 N. Grand Ave., St. Louis 3, Mo.

Forthcoming Events

August

29–31. Symposium on Metabolic Aspects of Transport across Cell Membranes, Madison, Wis. (H. Lardy, Inst. for Enzyme Research, 1702 University Ave., Madison 5.)

29–2. Infrared Spectroscopy Inst., 6th annual Nashville, Tenn. (N. Fuson, ISI, Fisk Univ., Nashville 8.)

29–3. Mathematical Assoc. of America, Ann Arbor, Mich. (H. M. Gehman, Univ. of Buffalo, Buffalo 14, N.Y.)

29–5. International Astronomical Union, Dublin, Ireland. (P. T. Oosterhoff, IAU, Leiden Observatory, Leiden, Netherlands.)

29–6. International Horticultural Cong., 14th, The Hague, Netherlands. (G. de Bakker, International Comm. for Horticulture, Bezuidenhoutseweg 30, The Hague.)

30–31. Soc. for Industrial and Applied Mathematics, 2nd general, Ann Arbor, Mich. (G. W. Preston, Research Div., Philco Corp., Philadelphia 34, Pa.)

30–2. American Mathematical Soc., 60th summer, Ann Arbor, Mich. (AMS, 80 Waterman St., Providence 6, R.I.)

30–2. Biological Photographic Assoc., 25th annual, Milwaukee, Wis. (L. C. Massopust, Sr., Marquette Univ. School of Medicine, Milwaukee 3.)

31–1. Conf. on Low Temperature Physics, Paris, France. (L. Weil, Institut Fourier, Place du Doyen Gosse, Grenoble, Isère, France.)

31–2. American Sociological Soc., Washington, D.C. (W. J. Warner, ASS, New York Univ., Washington Sq., New York 3.)

31–3. United Chapters of Phi Beta Kappa, 24th triennial, Minneapolis, Minn. (C. Billman, 1811 Q St., NW, Washington 9.)

31–6. International Assoc. for Hydraulic Research, 6th plenary, The Hague, Netherlands. (L. G. Straub, St. Anthony Falls Hydraulic Lab., Minneapolis 14, Minn.)

31–7. British Assoc. for the Advancement of Science, annual, Bristol, Eng. (BAAS, Burlington House, London, W.1.)

31–8. International Cong. of Refrigeration, Paris, France. (L. Weil, Institut Fourier, Place du Doyen Gosse, Grenoble, Isère, France.)

September

1. Assoc. for Symbolic Logic, Ann Arbor, Mich. (J. Barlaz, Rutgers Univ., New Brunswick, N.J.)

2–7. American Psychological Assoc., San Francisco, Calif. (F. H. Sanford, APA, 1333 16 St., NW, Washington 6.)

2–7. Psychometric Soc., San Francisco, Calif. (J. B. Carroll, Harvard Univ., 13 Kirkland St., Cambridge 38, Mass.)

2–9. International Cong. of Anthropological and Ethnological Sciences, 5th, Philadelphia, Pa. (A. Kidder, Univ. of Pennsylvania, Philadelphia 4.)

3–7. International Council of Women Psychologists, San Francisco, Calif. (M. G. Reiman, Milwaukee County Guidance Clinic, Milwaukee 3, Wis.)

4–7. International Cong. of Vitamin E, 3rd, Venice, Italy. (K. E. Mason, Dept. of Anatomy, Univ. of Rochester School of Medicine and Dentistry, 260 Crittenden Blvd., Rochester 20, N.Y.)

4–11. International Cong. of Historical Sciences, 10th, Rome, Italy. (F. Chabod, X^e Congres International des Sciences Historiques, Université, Rome.)

5–8. American Soc. for Pharmacology and Experimental Therapeutics, Iowa City, Iowa. (C. C. Pfeiffer, Dept. of Pharmacology, Emory Univ., Emory University, Ga.)

5–9. American Inst. of Biological Sciences, Michigan State Univ., East Lansing, Mich. (H. T. Cox, AIBS, 2000 P St., NW, Washington 6.)

The following 24 societies will hold their meetings along with the AIBS during the same week at East Lansing, Mich.

American Bryological Soc. (L. J. Gier, Dept. of Biology, Wm. Jewell College, Liberty, Mo.)

McGRAW-HILL

COLLEGE PHYSICS

By ROBERT L. WEBER
MARSH W. WHITE
KENNETH V. MANNING

Pennsylvania State University

Second Edition. 820 pages, $6.50

College Physics presents the basic ideas of physics for students of science and engineering at the college level. Simple, direct, and concise explanations and solved numerical examples help students acquire exact knowledge of physical principles. Facility in the application of physical principles is encouraged by discussion questions, careful treatment of units, proper use of significant figures, and pairing of problems, with answers given for those which are even-numbered. The vitality of physics is emphasized, especially in chapters on atomic and nuclear physics and in the biographical notes and portraits of all Nobel prize winners in physics.

The historical development of our modern ideas is stressed by the introduction of significant experimental and theoretical contributions systematically related to the progress of the development of physical thought.

OTHER IMPORTANT McGRAW-HILL BOOKS

PECK
ELECTRICITY AND MAGNETISM
476 pages, $7.50

BECKER
INTRODUCTION TO THEORETICAL MECHANICS
420 pages, $8.00

WISLON, DECIUS, and CROSS
MOLECULAR VIBRATIONS
The Theory of Infrared and Raman Vibrational Spectra
390 pages, $8.50

WILSON
AN INTRODUCTION TO SCIENTIFIC RESEARCH
376 pages, $6.00

McGRAW-HILL BOOK COMPANY, INC.
330 WEST 42ND STREET NEW YORK 36, N. Y.

SEND FOR COPIES ON APPROVAL

American Fern Soc. (M. E. Faust, 501 University Pl., Syracuse 10, N.Y.)

American Microscopical Soc. (C. J. D. Brown, Dept. of Zoology and Entomology, Montana State College, Bozeman.)

American Soc. for Horticultural Science. (F. S. Howlett, Ohio Agr. Exptl. Sta., Wooster.)

American Soc. of Human Genetics. (D. C. Rife, Ohio State Univ., Columbus.)

American Soc. of Limnology and Oceanography. (B. H. Ketchum, Woods Hole Oceanographic Inst., Woods Hole, Mass.)

American Soc. of Naturalists. (W. P. Spencer, Dept. of Genetics, Univ. of Texas, Austin 12.)

American Soc. of Plant Physiologists. (J. F. Stanfield, Dept. of Botany, Miami Univ., Oxford, Ohio.)

American Soc. of Plant Taxonomists. (R. C. Rollins, Gray Herbarium, Harvard Univ., Cambridge 38, Mass.)

American Soc. of Zoologists. (R. C. Kempton, Dept. of Zoology, Vassar College, Poughkeepsie, N.Y.)

Beta Beta Beta. (B. R. Weimer, Bethany College, Bethany, W.Va.)

Biometric Soc. (C. I. Bliss, Box 1106, New Haven 4, Conn.)

Botanical Soc. of America. (H. C. Bold, Dept. of Biology, Vanderbilt Univ., Nashville, Tenn.)

Ecological Soc. of Ameria. (J. F. Reed, Dept. of Botany, Univ. of Wyoming, Laramie.)

Genetics Soc. of America. (C. P. Oliver, Dept. of Zoology, Univ. of Texas, Austin.)

Mycological Soc. of America. (E. S. Beneke, Botany and Plant Pathology Dept., Michigan State Univ., East Lansing.)

National Assoc. of Biology Teachers. (P. V. Webster, Bryan City Schools, Bryan, Ohio.)

Nature Conservancy. (G. B. Fell, 4200 22 St., NE, Washington 18.)

Phycological Soc. (P. C. Silva, Dept. of Botany, Univ. of Illinois, Urbana.)

Potato Assoc. of America. (R. W. Hougas, Dept. of Genetics, Univ. of Wisconsin, Madison 6.)

Soc. for Industrial Microbiology. (C. L. Porter, Dept. of Biological Sciences, Purdue Univ., West Lafayette, Ind.)

Soc. of Protozoologists. (N. D. Levine, College of Veterinary Medicine, Univ. of Illinois, Urbana.)

Soc. for the Study of Evolution. (H. Lewis, Dept. of Botany, Univ. of California, Los Angeles 24.)

Soc. of Systematic Zoologists, (R. E. Blackwelder, 3728 Second St. South, Arlington 4, Va.)

5–9. Econometric Soc., Ann Arbor, Mich. (R. Ruggles, Box 1264, Yale Station, New Haven, Conn.)

5–10. World Cong. of Anaesthesiologists, Scheveningen, Netherlands. (W. A. Fentener van Vlissingen, WCA, Bilthoven, Netherlands.)

6–11. American Physiological Soc., Boston, Mass. (M. O. Lee, APS, 9650 Wisconsin Ave., Washington 14.)

6–16. Chicago Inst. for Hospital Administrators, 23rd, Chicago, Ill. (American College of Hospital Administrators, 620 N. Michigan Ave., Chicago 11.)

7–9. American Political Science Assoc., Boulder, Colo. (E. M. Kirkpatrick, 1785 Massachusetts Ave., NW, Washington 6.)

7–9. American Soc. of Photogrammetry, Los Angeles, Calif. (C. E. Palmer, 1000 11 St., NW, Washington 1.)

9–10. Soc. of General Physiologists, Woods Hole, Mass. (J. B. Buck, NIH, Bethesda 14, Md.)

9–10. Symposium on Electroluminescence and Photoconduction in Inorganic Phosphors, Brooklyn, N.Y. (J. J. Dropkin, Polytechnic Inst. of Brooklyn, Brooklyn 1.)

9–12. Sigma Delta Epsilon, Minneapolis, Minn. (Mary Gojdics, Barat College, Lake Forest, Ill.)

10. International Conf. of Medical and Reference Librarians, Brussels, Belgium. (Miss C. de Looze, Oeuvre Nationale Belge de Defense contre la Tuberculose, 56, rue de la Concorde, Bruxelles.)

10–11. Soc. for Social Responsibility in Science, annual, Swarthmore, Pa. (J. Engelberg, 4715 Baltimore Ave., Philadelphia 43, Pa.)

10–15. International Cong. on Cosmic Radiation, Mexico, D.F., Mexico. (H. A. Barton, IUPAP, 57 E. 55 St., New York 22.)

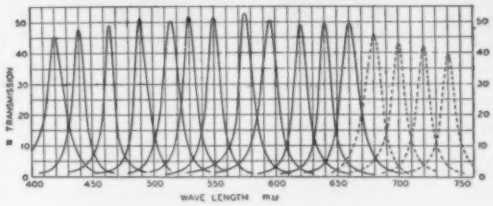
11–16. American Chemical Soc., Minneapolis, Minn. (A. H. Emery, 1155 16 St., NW, Washington 6.)

11–16. Laurentian Hormone Conf. AAAS, annual, Estes Park, Colo. (Committee on Arrangements, 222 Maple Ave., Shrewsbury, Mass.)

(See 15 July issue for comprehensive list)

BALZERS Interference Filters

for isolating narrow spectral bands



Spectral Range: 400-900 millimicrons
Spectral Width: 12-15 mμ, Transm.: 45-50%
Size: 2" x 2". Other sizes on order.

For

Flame Photometry and Color Densitometry
Microscopy and Photomicrography
Colorimetry and Fluorimetry

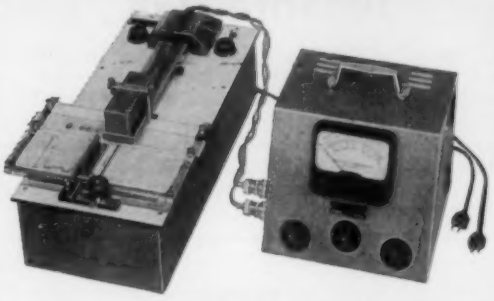
also in reflectometry, light scattering measurements, microcolorimetry, refractometry, polarimetry, and in all other fields requiring monochromatic light in the visible and near-infrared range.

Write for Bulletin #180 to

PHOTOVOLT CORP.
95 Madison Ave. New York 16, N. Y.

PHOTOVOLT Densitometer

for Partition Chromatography and Paper Electrophoresis



A photoelectric precision instrument for the rapid and convenient evaluation of strips and sheets of filter paper in partition chromatography and paper electrophoresis.

Write for Bulletin #800 to

PHOTOVOLT CORP.
95 Madison Avenue New York 16, N. Y.

Also

Colorimeters	pH meters	Electronic Photometers
Fluorimeters	Reflection Meters	Multiplier Photometers
Nephelometers	Glossmeters	Interference Filters

Now available . . .

Adenosine Triphosphate (ATP); Amygdalin; Amylase; Animal Lecithin; Ascorbic Acid Oxidase; Bacitracin; BAL; Biotin, cryst.; Caffeic Acid; Carotene, cryst.; Catalase; Cellulase; Chlorogenic Acid; Chorionic Gonadotropin; Circulatory Hormone; Colchicine; Cytidylic Acid; Cytochrome C; Dehydroascorbic Acid; Diacetoneamine; Dihydroxyacetone; Dihydroxyphenylalanine (DOPA); Dipyridyl; Edestin; Emulsin; Erythritol; N-Ethylpiperidine; Fibroin; Folic Acid; Galacturonic Acid; Gentistic Acid; Girard Reagents P and T; Gliadin; Glucose Pentaacetate; Glucuronic Acid; Glyceraldehyde; Glyceric Acid; Heparin; Hordenine; Hyaluronidase; Hydrindene; 2-Hydroxyadipaldehyde; Humulon; Indan; Isoascorbic Acid; Isopropylarterenol; Kojic Acid; Kynurenic Acid; Lanthionine; Lipase; Lysozyme; Lyxose; Malononitrile; Maltase; Melezitose; Mesobilirubinogen; Muscle Adenylic Acid; p-Nitrophenylphosphate; Nucleoprotein; Orcinol; Pancreatin; Pantothenyl Alcohol; Penicillinase; Peroxidase; Phenazine; Phenylpyruvic Acid; Phloridzin; Phosphorylase; Piperin; Porphyrindine; Protamines; Protoporphyrin; Pyridoxal; Pyridoxamine; Pyrocatechuic Acid; Pyruvic Aldehyde; Ribonuclease; Saccharic Acid; Salmine; Serine Phosphoric Acid; Spermidine; Spermine; Thioacetic Acid; Thiocytosine; Thyroxine; Trigonelline; Triphenyltetrazolium Chloride; Tripyridyl; Trypsinogen; Tyrosinase; Tyrothricin; Urease; Uricase; Uridine; Vitellin; Xanthosine.

Ask us for others!

DELTA CHEMICAL WORKS, INC.
23 West 60th St. New York 23, N. Y.
Telephone Plaza 7-6317

DIFCO

Dehydrated Culture Media DIFCO

The utmost in efficiency and economy in the bacteriological laboratory is realized through use of Dehydrated Culture Media, Difco.

Convenience—any medium can be instantly prepared.
Stability—media can be kept without deterioration.
Availability—each medium is instantly available.
Completeness—no additional ingredients are required.
Uniformity—successive lots are identical.
Comparability—dependable, comparative studies are possible in widely separated laboratories over long periods of time when standardized Difco Products are employed.

Specify "DIFCO"

DIFCO LABORATORIES
DETROIT 1, MICHIGAN

APPLICATION FOR HOTEL RESERVATIONS

122nd AAAS MEETING

Atlanta, Ga., December 26-31, 1955

The list of hotels and their rates and the reservation coupon below are for your convenience in making your hotel room reservation in Atlanta. Please send your application, *not* to any hotel directly, but to the AAAS Housing Bureau in Atlanta and thereby avoid delay and confusion. The experienced Housing Bureau will make assignments promptly; a confirmation will be sent you in two weeks or less. **As in any city, single-bedded rooms may become scarce; double rooms for single occupancy cost more; if possible, share a twin-bedded room with a colleague—and also save money.** Mail your application *now* to secure your first choice of desired accommodations. All requests for reservations must give a definite date and estimated hour of arrival, and also probable date of departure.

HOTELS AND RATES PER DAY

★ **Hotels starred have sessions in their public rooms.** Most hotels will place comfortable rollaway beds in rooms or suites at 2.50 or 3.00 per night. For a list of headquarters of each participating society and section—and for information on **dormitory accommodations** at Atlanta University and Georgia Institute of Technology—please see *Science*, July 22, or *The Scientific Monthly*, August.

Hotel★	Single	Double Bed	Twin Bed	Suite
Georgia Tech Zone				
Atlanta Biltmore★	6.00–10.00	8.00–14.00	10.00–14.00	15.00–50.00
Cox-Carlton	4.00– 6.00	6.00– 8.00	6.00– 8.00	14.00–16.00
Georgian Terrace	5.00– 8.00	8.50–11.00	8.50–12.00	12.00–22.00
Peachtree Manor	5.00– 8.00	7.50– 9.50	8.50–12.00	15.00–28.00
Downtown Zone				
Atlantan	4.00– 5.50	6.00– 8.50	8.50–10.50	17.00
Dinkler Plaza★	6.00– 8.50	7.00–11.50	13.00–15.00	12.00–35.00
Georgia★	4.00– 7.00	6.00– 9.00	7.00–10.00	15.00–20.00
Hampton	2.50– 4.00	3.50– 5.00	5.00– 7.00	
Henry Grady★	5.50–12.00	9.00–12.00	9.50–12.00	16.00–25.00
Imperial	4.00– 5.50	6.00– 6.50	6.50– 7.00	
Jefferson	3.00– 3.50	4.00– 5.00	4.50– 5.00	
Peachtree on Peachtree	5.00– 7.00	7.50–10.50	8.50–10.50	10.00–18.00
Piedmont★	5.50– 8.00	7.50–10.00	10.00–14.00	20.00–25.00
As required by local laws, the following are available for Negro members and visitors:				
Royal Hotel 214 Auburn Ave., N.E.	4.00	5.00		
Savoy Hotel 239 Auburn Ave., N.E.	2.50	3.50– 4.50		
University Motel 55 Northside Drive, N.W.	5.00	8.00		

THIS IS YOUR HOTEL RESERVATION COUPON

AAAS Housing Bureau
Room 912, Rhodes-Haverty Bldg.
Atlanta 3, Ga.

Date of Application .....

Please reserve the following accommodations for the 122nd Meeting of the AAAS in Atlanta, Dec. 26–31, 1955:

TYPE OF ACCOMMODATION DESIRED

Single Room ..... Desired Rate ..... Maximum Rate .....
Double-Bedded Room ..... Desired Rate ..... Maximum Rate ..... Number in party .....
Twin-Bedded Room ..... Desired Rate ..... Maximum Rate .....
Suite ..... Desired Rate ..... Maximum Rate ..... Sharing this room will be:

(Attach list if this space is insufficient. The name and address of each person, including yourself, must be listed.)

.....

.....

First Choice Hotel ..... **Second Choice Hotel** ..... **Third Choice Hotel** .....

DATE OF ARRIVAL ..... DEPARTURE DATE .....
(These must be indicated—add approximate hour, a.m. or p.m.)

NAME .....
(Individual requesting reservation) (Please print or type)

ADDRESS .....
(Street) (City and Zone) (State)

Mail this now to the Housing Bureau. **Rooms will be assigned and confirmed in order of receipt of reservation.**

PERSONNEL PLACEMENT

YOUR ad here reaches over 32,000 foremost scientists in the leading educational institutions, industrial laboratories, and research foundations in the U S. and 76 foreign countries —at a very low cost.

CLASSIFIED: 18¢ per word, minimum charge $3.60. Use of Box Number counts as 10 additional words.

DISPLAY: Rates listed below — no charge for Box Number. Monthly invoices will be sent on a charge account basis—provided that satisfactory credit is established.

Single insertion	**$19.50 per inch**
7 times in 1 year	**17.50 per inch**
13 times in 1 year	**16.00 per inch**
26 times in 1 year	**14.00 per inch**
52 times in 1 year	**12.50 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

POSITIONS WANTED

Bacteriologist; recent Ph.D. desires position in industry, teaching with research affiliation, or in medical field. Experience in diagnostic and research bacteriology; publications. Box 209, SCIENCE. X

Botanist; M.A., female, 29. Research in academic or commercial position. Box 207, SCIENCE. X

(a) Endocrinologist, Ph.D.; 6 years, research department, large organization; prefers industrial research; will consider academic research. **(b) Parasitologist,** Ph.D.; well trained malariology and related protozoan diseases; 3 years on staff research institution. Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

POSITIONS OPEN

Biophysicist–Electrophysiologist, Ph.D. or equivalent. Experience with bioelectric potentials and electronics desirable. For university research position. Academic rank and salary to $6,000 according to training and experience. Box 177, SCIENCE. 7/29, 8/5, 12

POSITIONS OPEN

Experimental Physicist with experience in electronics, accelerator techniques, radiation physics, etc. for Biophysics Research Laboratory of Tumor Clinic, Michael Reese Hospital, Chicago 16, Illinois. Minimum salary $7000 for Ph.D. Also opening for qualified **Biophysicist.** Application to Erich Uhlmann, M.D. at the above address. 8/5

Histologist—M.S. or equivalent independent research experience for histological-histochemical research in a large Chicago cosmetics company. Experience with tissue metabolism techniques desirable. Position offers excellent potential for advancement in biochemical research. Minimum starting salary $4500. Company insurance and retirement plans and many other excellent employee benefits. Write, giving full details in first letter: Personnel Department, The Toni Company, Room 440, Merchandise Mart, Chicago 54, Illinois. X

(a) Organic Medicinal Chemist; Ph.D. interested in research; experience not important; noted pharmaceutical house. **(b) Research Assistant;** Bacteriology; B.A.; project relating to bacteriophage of anaerobic bacteria; well-known Midwest university. **(c) Chemist**; recent graduate; one of country's finest university hospitals; East. **(d) Senior Bacteriologist**; city public health laboratory; $5000; excellent resort location. **(e) Biochemist**; Ph.D. to do research, act as control supervisor, private laboratory doing research, testing, foods and pharmaceuticals; can consider microbiologist or organic chemist with biochemistry background; minimum $7000. Woodward Medical Personnel Bureau, 185 N. Wabash, Chicago. X

Ph.D.; Physics and Mathematics man with college teaching experience, to teach Physics, Mathematics and electives in Physical Science. Associate Professorship, State University Teachers College, Plattsburgh, New York. Starting salary $5700 with automatic increments. Forward credentials to F. Reese Nevin, Department Chairman. X

(a) Physician, preferably with several years of private practice, to join professional staff, pharmaceutical company and, also, **physician** qualified for clinical investigations of new drugs; East. **(b) Technical Director**; Ph.D., Pharmacology or Pharmacy; ethical pharmaceutical company; large city, university medical center; Midwest. **(c) Head, Pharmacology department,** university affiliated research institution; program calls for interest in chemotherapy of neoplastic disorders and metabolic antagonists; one oriented toward academic and investigative pharmacology required; East; $8,000–$10,500. S7-5 Medical Bureau (Burneice Larson, Director), Palmolive Building, Chicago. X

POSITIONS OPEN

Research Biochemist desired as member of a surgical research team working in a large university hospital in western New York State. Starting salary $4800. Box 208, SCIENCE. X

Research Physiologist: join multidiscipline team (physiologist, psychologist, industrial designer, and anthropologist) working on human factors in design current and future aviation equipment. One year contract begins 1 Oct. $5000–$6400 depending on qualifications. Some travel as evaluation team, but principal task to draft and execute extensive tests in laboratories of Tufts University. Address W. K. Carter, Director Human Factors Project, Tufts University, Medford 55, Mass. X

BIOLOGISTS

Established medium-size pharmaceutical firm has several attractive positions available in basic research. Company has just completed the latest step in a continuing expansion of its research program—a modern, air-conditioned, completely equipped research building in a mid-New York State rural community in popular hunting and fishing area. Complete employee benefit program offered.

PHARMACOLOGIST — Ph.D. or M.D., male, 30–40 years of age, to head division of Pharmacology. Training in pharmacodynamics and several years experience in application of pharmacological techniques to development of new medicinal agents essential. Some supervisory and administrative experience desirable.

TOXICOLOGIST — Ph.D. or equivalent training, to assume responsibility for toxicological work on new medicinal agents. Practical experience in toxicology essential and general knowledge of pharmacology and physiology desirable.

VIROLOGIST—B.S. or M.S. in Virology or Bacteriology, for responsible position in new Virology section. Two or more years experience in any two of the following and some experience in other essential: serological examinations, animal innoculations, tissue culture preparation, and chick embryo innoculation.

Please forward résumés to Personnel Department, Eaton Laboratories, Division of The Norwich Pharmacal Company, Norwich, New York.

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

CLASSIFIED: 25¢ per word, minimum charge $6.00. Use of Box Number counts as 10 additional words. Correct payment to SCIENCE must accompany ad.

DISPLAY: Rates listed below—no charge for Box Number. Monthly invoices will be sent on a charge account basis —provided that satisfactory credit is established.

Single insertion	**$19.50 per inch**
7 times in 1 year	**17.50 per inch**
13 times in 1 year	**16.00 per inch**
26 times in 1 year	**14.00 per inch**
52 times in 1 year	**12.50 per inch**

For PROOFS on display ads, copy must reach SCIENCE 4 weeks before date of issue (Friday of every week).

BOOKS AND MAGAZINES

WANTED TO PURCHASE . . .
SCIENTIFIC PERIODICALS and BOOKS
Sets and runs, foreign and domestic. Entire libraries and smaller collections wanted
WALTER J. JOHNSON • 125 East 23rd St., New York 10, N. Y.

Your sets and files of scientific journals

are needed by our library and institutional customers. Please send us lists and description of periodical files you are willing to sell at high market prices. Write Dept. A3S, J. S. CANNER, INC. Boston 19, Massachusetts

PROFESSIONAL SERVICES

CONSULTATION RESEARCH

MICROBIOLOGY
PHARMACOLOGY
BIOCHEMISTRY
TOXICOLOGY
ANIMAL HISTOPATHOLOGY

SOUTH SHORE ANALYTICAL AND RESEARCH LABORATORY, Inc.
148 ISLIP AVE. ISLIP, N. Y.

BOOK MANUSCRIPTS INVITED

Write for Free Booklet SC telling how we can publish your book. All subjects considered. New authors welcome.
VANTAGE PRESS, Inc. • 120 W. 31 St., New York 1
In Calif.: 6253 Hollywood Blvd., Hollywood 28

FOOD RESEARCH LABORATORIES, INC.
Founded 1922
Philip B. Hawk, Ph.D., President
Bernard L. Oser, Ph.D., Director
Research • Analyses • Consultation
Biological, Nutritional, Toxicological Studies for the Food, Drug and Allied Industries
48-14 33rd Street, Long Island City 1, N.Y.

• RESEARCH
• CONSULTATION
• ANALYSES

The MARKET PLACE

BOOKS • SERVICES • SUPPLIES • EQUIPMENT

PROFESSIONAL SERVICES

WISCONSIN ALUMNI RESEARCH FOUNDATION

LABORATORY SERVICES

Project research and consultation in Biochemistry, Chemistry, Bacteriology and Entomology

Screening of compounds for insecticidal, fungicidal and bactericidal properties • Biological evaluation and chemical determination of insecticides • Peet-Grady and C.S.M.A. aerosol tests • Warfarin assays

Write for price schedule

WISCONSIN ALUMNI RESEARCH FOUNDATION

P. O. BOX 2059-V • MADISON 1, WISCONSIN

MERCURY CLEANING DISTILLING

Ship us your mercury. We return it immediately in heavy, clear glass bottles induction distilled in glass under vacuum guaranteed to meet A.C.S. specs. Minimum 10 pounds — slight loss in processing Identify shipment.

only 50¢ PER LB

EBERBACH & SON ANN ARBOR, MICH

SUPPLIES AND EQUIPMENT

ALBINO RATS* *"From the hand of the veterinarian to research"*

HYPOPHYSECTOMIZED RATS

**Descendants of the Sprague-Dawley and Wistar Strains*

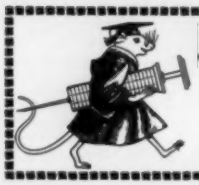
HENRY L. FOSTER, D.V.M.
President and Director
THE CHARLES RIVER BREEDING LABS.
Wilmington, Mass.

C^{14} COMPOUNDS

send for comprehensive list

RESEARCH SPECIALTIES CO

1148 Walnut St., Berkeley 7, Calif.



SWISS MICE

TACONIC FARMS

GERMANTOWN NEW YORK
GERMANTOWN 3535

RESEARCH BIOCHEMICALS

OVER 1500

NUTRITIONAL BIOCHEMICALS Corp.
Cleveland 28, Ohio

Write for your copy—free catalogue

SUPPLIES AND EQUIPMENT

RATS

Long-Evans (PAF)
Wistar (PAF)

Bred for Research Work by Research Workers

PACIFIC ANIMAL FARMS

2457 Fletcher Dr., Los Angeles 39, Calif.

MACHLETT

Your assurance of the finest laboratory supplies, scientific instruments, chemicals and glassblowing.

E. Machlett & Son • 220 E. 23rd St. • N. Y. 10, N. Y.

BEAGLES

Healthy — AKC Registered — Immunized
$25 to $50 each; F.O.B. Ithaca
DOG FARM — RR1 — Ithaca, N. Y.

All AMINO ACIDS— natural, synthetic, unnatural, Rare Sugars, Biochemical Products, Reagents, New Pharmaceuticals in stock. Write or phone Plaza 7-8171 for complete price list.

BIOS LABORATORIES, INC. 17 West 60th Street, New York 23, N. Y.

MICE

"A" Strain
"C" Strain

Medical Center Laboratory
519 E. Club Blvd., Durham, N. C.

Highly Purified—Research Grade

FATTY ACIDS
ESTERS ALCOHOLS

Kilogram Quantities

Applied Science Laboratories, Inc.

140 N. Barnard St., State College, Pa. Phone AD 8-6282

• **HYPOPHYSECTOMIZED RATS**

Shipped to all points via Air Express
For further information write

HORMONE ASSAY LABORATORIES, Inc. • 8159 South Spaulding Ave. Chicago 29, Ill.

GME

714 MARKET PLACE
MADISON 3, WIS.

FRACTIONATORS • TRANSFERATORS
CARDIOVASCULAR RECORDERS
ELECTROENCEPHALOGRAPHS
WARBURG APPARATUS
WATER BATHS

THE LUMINESCENCE OF BIOLOGICAL SYSTEMS

A Symposium Volume of the American Association for the Advancement of Science

Edited by Frank H. Johnson, Princeton University

6 x 9 inches, 466 pages, 161 illustrations; author, genera and species, and subject indexes; bibliographies, clothbound

Retail price $7.00 AAAS Members' prepaid order price **$6.00**

This volume includes papers presented by some thirty leading investigators at a conference on Luminescence in April 1954. Fundamental aspects of "cold light"—bioluminescence, fluorescence, phosphorescence, and chemiluminescence—are considered in detail. The latest advances reported here emphasize the general significance of researches in this field and point to problems that are a challenge for future work. The range of material critically examined extends from the purely physical through the biochemical and physical chemical to the purely physiological and ecological. In addition to chemically defined systems in solution, a wide range of organisms are considered, including green plants, bacteria, fungi, *Cypridina*, fireflies, *Gonyaulax* and other dinoflagellates, and various higher animals. An important feature is a comprehensive survey and discussion of luminous organisms of Japan and the Far East.

CONTENTS

Survey of Luminous Organisms: Problems and Prospects
E. Newton Harvey, Princeton University

Luminescence Spectroscopy of Molecules and the Photosynthetic System
R. S. Becker and M. Kasha, Florida State University

Light Saturation of Delayed Light Production in Green Plants
William Arnold, Oak Ridge National Laboratory

Fluorescence Spectrophotometry of Photosynthetic Pigments
C. Stacy French, Carnegie Institution of Washington, Stanford, California

Kinetics of Chemiluminescence of the 2,3-Dihydrophthalazine-1,4-diones
Paul C. Wilhelmsen, Walnut Creek, California; Rufus Lumry, University of Minnesota; and Henry Eyring, University of Utah

Spectroscopic Investigations of Luminescent Systems
C. J. P. Spruit and A. Spruit-van der Burg, Landbouwhogeschool, Wageningen, Netherlands

Recent Studies on the Chemistry of *Cypridina* Luciferin
Frederick I. Tsuji, Aurin M. Chase, and E. Newton Harvey, Princeton University

Biochemistry of Firefly Luminescence
W. D. McElroy, Johns Hopkins University, and J. W. Hastings, Northwestern University

Firefly Luciferin
Bernard L. Strehler, University of Chicago

Factors and Biochemistry of Bacterial Luminescence
Bernard L. Strehler, University of Chicago

Purification and Properties of Bacterial Luciferase
J. W. Hastings, Northwestern University, and W. D. McElroy, Johns Hopkins University

Inhibition and Activation of Intracellular Luminescence
Frank H. Johnson, Princeton University

Physiological Control of Luminescence in Animals
J. A. C. Nicol, Marine Biological Laboratory, Plymouth, England

Some Reflections on the Control of Bioluminescence
John Buck, National Institutes of Health

Luminous Organisms of Japan and the Far East
Y. Haneda, No. 456, Namama Zushi, Kanagawa Pref., Japan

Ecology of Autrophic Marine Dinoflagellates with Reference to Red Water Conditions
John H. Ryther, Woods Hole Oceanographic Institute

Bioluminescence in *Gonyaulax polyedra*
F. T. Haxo and Beatrice M. Sweeney, Scripps Institution of Oceanography

Mail your order now

To: American Association for the Advancement of Science
1025 Connecticut Avenue, N. W.
Washington 6, D. C.

Date .....

Please accept my order for ..... copy(ies) of THE LUMINESCENCE OF BIOLOGICAL SYSTEMS. My check or money order in the amount of $..... is enclosed.

NAME .....

ADDRESS .....

CITY ..... ZONE ..... STATE .....

English Agents: Bailey Bros. & Swinfen, Ltd., 46, St. Giles High Street, London, W.C.2

A New International Centrifuge

FOR THE

Modern Laboratory

More than just a Centrifuge in a convenient cabinet, the Model U offers years-ahead features and unmatched performance.

● aerodynamic guard bowl ventilating system ● new stainless steel interior ● space saving stainless steel auxiliary cover ● electric tachometer ● electric time clock ● unique air filtering system ● spring loaded hinge ● new vibration dampening system resulting in smooth operation without the "shaker" action of over-flexible mountings ● plus the versatility of 84 interchangeable accessory combinations

For detailed information about the above features of the all new Model U Internation Centrifuge, call, wire or write E. Machlett & Son.

MACHLETT

TELEPHONES:
NEW YORK
LExington 2-1311
NEW JERSEY
Elizabeth 4-1330

E. MACHLETT & SON

ESTABLISHED 1897

A COMPLETE SERVICE FOR THE LABORATORY

APPARATUS • INSTRUMENTS • CHEMICALS • GLASS BLOWING

220 EAST 23rd STREET • NEW YORK 10, N. Y.

EMSON

CABLE:
EMSONGLAS
•
TELETYPE:
N. Y. 1-2444